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October 1st, 2008

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Subject: Deliverable Number 0019, Joint Sea-Based Logistics

Reference: Strategic Mobility 21 Contract N00014-06-C-0060

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Strategic Mobility 21 Program Manager

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Strategic Mobility 21

Joint Sea Based Logistics

Contractor Report 0019

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In fulfillment of the requirements for:

FY 2005 Contract No. N00014-06-C-0060
Strategic Mobility 21 – CLIN 0019

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October 1, 2008

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REPORT DOCUMENTATION PAGE					Form Approved OMB No. 0704-0188	
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1. REPORT DATE (DD-MM-YYYY) 01-10-2008		2. REPORT TYPE Technical		3. DATES COVERED (From - To) Feb 2006 - Oct 2008		
4. TITLE AND SUBTITLE Strategic Mobility 21 Joint Sea Based Logistics				5a. CONTRACT NUMBER N00014-06-C-0060		
				5b. GRANT NUMBER		
				5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S) Mallon, Lawrence G.				5d. PROJECT NUMBER		
				5e. TASK NUMBER		
				5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) California State University, Long Beach Foundation 6300 State University Drive, Suite 220 Long Beach, CA 90815				8. PERFORMING ORGANIZATION REPORT NUMBER Contractor Report 0019		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Office of Naval Research 875 North Randolph Street, Room 273 Arlington, VA 22203-1995				10. SPONSOR/MONITOR'S ACRONYM(S) ONR		
				11. SPONSOR/MONITOR'S REPORT NUMBER(S) CLIN 0019		
12. DISTRIBUTION/AVAILABILITY STATEMENT DTIC Distribution Statement A: Approved for public release; distribution is unlimited.						
13. SUPPLEMENTARY NOTES						
14. ABSTRACT <p>The Joint Deployment and Distribution Support Platform (JDDSP) design concept developed by SM21 includes distribution support for joint sea-based forces in its design and will support many of the to-be requirements. The objective of the SM21-JDDSP sea based logistics architecture is to support the timely distribution of the right classes of supply in sufficient quantities to allow sustained joint combat operations. Conceptually the SM21 JDDSP would support sea-based logistics through the use of advanced distribution information management systems and the management of sustainment buffer stocks at strategic regional locations in the Continental United States (CONUS) and at advanced bases. For initial sea based logistics experimentation, prototype JDDSP capabilities could be deployed and tested at the Southern California Logistics Airport (SCLA) in Victorville, CA or at a potential advanced base location.</p>						
15. SUBJECT TERMS <p>Joint Operating Area (JOA), Sea-Based Logistics optimization (SBLO), Joint Deployment and Distribution Support Platform (JDDSP), Continental United States (CONUS), Southern California logistics Airport (SCLA), Service Oriented Architecture (SOA), Joint Integrating Concepts (JIC)</p>						
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES 73	19a. NAME OF RESPONSIBLE PERSON Dr. Lawrence G. Mallon	
a. REPORT U	b. ABSTRACT U	c. THIS PAGE U			19b. TELEPHONE NUMBER (Include area code) 1-562-985-7392	

Abstract

Sea based logistics requires highly refined business processes and supporting information management systems. This is especially true when you combine the impact of several critical factors: support to deployed joint forces in major combat operations; the restriction of no more than three T-AKE shuttle ships; up to a 2,000 nautical mile (NM) distance between the sea base and supporting advanced base; and, the requirement to minimize the logistics footprint in the joint operating area (JOA). This demanding environment will require highly refined logistics support processes and enabling technology. In order to complete a comprehensive analysis of the as-is sea based logistics environment, Strategic Mobility 21 (SM21) collaborated with the Center for the Commercial Deployment of Transportation Technologies (CCDoTT) Sea-Based Logistics Optimization (SBLO) project. The combined team first evaluated current doctrine, business processes, transportation assets, infrastructure, and information systems and then employed modeling and simulation tools to establish the support baseline. While the baseline environment can provide adequate support to Humanitarian Assistance operations, the as is baseline cannot provide the required level of support to joint combat operations. Given this condition, the team explored emerging concepts and doctrine to develop the framework for a to-be environment that will be further developed by SM21 in future program years.

The Joint Deployment and Distribution Support Platform (JDDSP) design concept developed by SM21 includes distribution support for joint sea-based forces in its design and will support many of the to-be requirements. The objective of the SM21-JDDSP sea based logistics architecture is to support the timely distribution of the right classes of supply in sufficient quantities to allow sustained joint combat operations. Conceptually the SM21 JDDSP would support sea-based logistics through the use of advanced distribution information management systems and the management of sustainment buffer stocks at strategic regional locations in the Continental United States (CONUS) and at advanced bases. For initial sea based logistics experimentation, prototype JDDSP capabilities could be deployed and tested at the Southern California Logistics Airport (SCLA) in Victorville, CA or at a potential advanced base location.

SM21 and Seabasing are complementary expeditionary logistical support programs. Both programs focus on providing access to critical deployment and distribution nodes. SM21 focuses on developing dual use¹ facilities that will assure access to our critical Strategic Ports in time of need. Likewise, Seabasing focuses on providing access to a foreign theater of operations when access to land based ports (seaports and airports) is limited by lack of infrastructure or political considerations. Sea based logistics offers SM21 the opportunity to demonstrate the scalability and adaptability of concepts developed for the JDDSP supporting service oriented architecture (SOA). To this end, the JDDSP SOS architecture was designed to include support to the advanced base and sea based logistics. The SOA basic requirements include the provision of timely, accurate, actionable data to those responsible for the execution of the “on the ground” functions required to deploy forces and distribute sustainment. SM21 will conduct a number of experiments and demonstrations to develop, refine, and validate the JDDSP SOA’s architecture. The initial set of proposed experiments is described in this document.

¹ Dual-use refers to the inherent ability of the system to be used equally well by both commercial and military users.

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1.0 INTRODUCTION

The Strategic Mobility 21 (SM21) Joint Deployment and Distribution Support Platform (JDDSP) design concept includes distribution support for Joint Sea Based Forces as a primary capability. Conceptually the SM21 JDDSP would support sea-based logistics through the use of advanced distribution information management systems and the management of sustainment buffer stocks at strategic regional locations in the Continental United States (CONUS). For initial sea based logistics experimentation, prototype JDDSP capabilities could be deployment and tested at the Southern California Logistics Airport (SCLA) in Victorville, CA. However, incremental deployment of the JDDSP system of systems concept could occur at several locations as part of the SM21 Sea Based logistics Experimentation Plan. The objective of the SM21-JDDSP sea based logistics architecture is to support the timely distribution of the right classes of supply in sufficient quantities to allow sustained combat operations².

Seabasing is one of several evolving Joint Integrating Concepts (JIC) that describe how Joint Force Commanders (JFC) 10 to 20 years in the future will achieve their combat objectives³. This technical report will describe how SM21 and the JDDSP architecture and support concepts will complement the Seabasing Joint Integrating Concept and the Seabasing Logistics Enabling Concept. Seabasing has been defined as:

The rapid deployment, assembly, command, projection, reconstitution, and re-employment of joint combat power from the sea, while providing continuous support, sustainment, and force protection to select expeditionary joint forces, without reliance on land bases within the Joint Operations Area (JOA). These capabilities expand operational maneuver options, and facilitate assured access and entry from the sea⁴.

To design the JDDSP sea-based logistics support architecture, SM21 has been collaborating with the Center for the Commercial Deployment of Transportation Technologies (CCDoTT) Sea-Base Logistics Optimization (SBLO) project being led by Logistics Management Institute (LMI) and the primary DoD stakeholders. The purpose of the joint SM21 - SBLO project was to identify improvements in concepts, technology and processes planned or used by military and commercial enterprises that will support and improve sea base logistics operations. The principal objective of the ongoing project is to provide both military and commercial Seabasing communities with independent and objective recommendations that improve Seabasing operational capabilities and efficiency.⁵ Jointly, LMI and SM21 have examined sea-based logistics concepts, emerging distribution technology, requirements, and doctrine using modeling and simulation tools. The partnership between the programs allows for development of critical capabilities necessary to execute expeditionary logistical support operations enabling concepts such as Sense and Respond Logistics which are components of the developing Focused Logistics capabilities.

² *Seabasing Logistics Enabling Concept*, with Annex A, December 2006, p. 3

³ *Seabasing Joint Integrating Concept*, Version 1.0, 1 August 2005

⁴ *Ibid*, page 5

⁵ *Sea base Logistical Optimization Project Plan*, John Strott LMI, 5 Mar 07

The jointly managed SM21 and SBLO projects were focused on validating prior Sea-Base requirements, specifically looking at:

- MPF (F) days of supply analysis
 - 2015 MEB and MPF (F)
 - LBS/Person/Day for all 10 Classes of Supply
 - Is MPF (F) load out sufficient until activation of sustainment pipeline
- T-AKE employment options for MPF (F) sustainment of 2015 MEB and Army BCT
- Advance base throughput and cargo handling requirements⁶

The joint project also examined three previous studies concerning Seabasing. Each of these studies focused on a different aspect of Seabasing from a quantitative analysis standpoint and applied a different dominant metric. These studies are summarized below:

- N-42 Study⁷. This study focused on the DOS that must be carried on the sea base until the continental United States (CONUS) logistics pipeline can be established to support the shore element. DOS was established using the number of days before a resupply (of the sea base) action was required to maintain stock objectives (operating levels) at minimum of 10 days “safety stock” level. It did not address connectors.
- N-81 RAND Study⁴. This study focused on the efficiency of connectors. It measured the maximum standoff distance in nautical miles (nm) that the sea base could be positioned and still resupply varying maneuver elements operating ashore at 100 percent of requirements. It did not specifically address resupply of the sea base.
- Army RAND Study⁵. This study focused on evaluating the raw capacity measured as “day until empty” of a container and a crane ship used to sustain an Army BCT ashore. It did not specifically address connectors and did not consider consumption by the sea base itself.

OPNAV42 provided the sea based logistics Extend Model as a tool for analyzing sea-based logistics support from the Advanced Base through T-AKE shuttle ships to the sea base. The model was designed to depict loading of the T-AKE utilizing the various classes of supply. For instance, the model will portray tradeoffs necessary to mix loads of different classes of supply such as a mixed load of Class I subsistence and Class IV Barrier Materials taking into consideration differences in storage requirements. SM21 supplemented the Extend Model with Excel based models. During the study, SM21 developed the functional requirements to extend the Southern California Agile Supply Network (SCASN) model to the advanced base.

The joint LMI-SM21 analyses lead to the conclusion that the Extend Model was useful in determining the fluctuating logistical requirements of Sea-Basing support. While LMI focused on advanced base, shuttle ship, and sea base transfer operations, SM21 defined the CONUS based operations required to get materials through the Ports of Embarkations for movement to the

⁶ Ibid

⁷ Chief of Naval Operations Strategic Mobility/Combat Logistics Division, Seabasing Logistics Concept, December 2006

advanced base for eventual loading onto the T-AKE⁸. CONUS ports will load commercial transoceanic carriers which will carry materials to an advanced base for trans-loading onto shuttle ships like the T-AKE for delivery to the seabase.

Sea-Basing is a broad concept; the initial Joint SM21 - SBLO project focused on the sustainment requirements of a Marine Expeditionary Brigade and an Army BCT until the CONUS sustainment pipeline can be established. SM21 is continuing the analysis through the development of the modeling capability of the CONUS sustainment support system, from the CONUS source of supply to the Advanced Base⁹. This modeling effort will support the proper execution of the sea based logistics mission as the deployment and distribution scenario changes to meet changing operational needs.

Of particular interest to SM21 for continued study is the need to develop processes, information management systems, and packaging technologies to support: the loading and selective offloading capabilities of T-AKE vessels; improve Total Asset Visibility at the deployment and distribution nodes; and the need to make shipments move more seamlessly through the distribution pipeline.

1.1 Seabasing and Sea Based Logistics Background

Seabasing is one of the three pillars of Naval (USN and USMC) Transformation. Since its initial development, the concept has evolved into the Joint and Navy Seabasing concept. The National Security Strategy, National Defense Strategy, and National Military Strategy all emphasize the need for military land access to retain global freedom of action. This requirement dictates that a diverse and flexible set of capabilities be developed and maintained to provide the ability to rapidly deploy, project, and sustain combat power without host nation support in the Joint Operating Area (JOA). Seabasing is currently being designed as a Joint, mobile logistics platform to support a wide range of contingencies including: humanitarian assistance (HA); counterinsurgency operations (COIN); major combat operations (MCO); and preemptive MCO with limited forward access. As since the end of the Cold War, Seabasing capabilities will be vital in the future to solving the difficulties imposed by either limited or blocked access to overseas bases.

The composition of the ship based system is still under developed; however it may include Carrier Strike Groups (CSGs), Expeditionary Strike Groups (ESGs) with a Marine Expeditionary Unit (MEU), Littoral Combat Ships (LCS), Surface Strike Groups (SSGs), Amphibious Forces (AF), Combat Logistic Forces (CLF), Army afloat program ships, Coalition Forces, and a new group of ships called the Maritime Prepositioning Group (MPG) comprised of the Maritime Prepositioning Force (Future) (MPF(F)) squadron and its embarked troops and sailors.

The SM21 program is focused on supporting the MPG's mission is to sustain both MPF(F) forces afloat and the Joint (Army Brigade-MEB)/Combined forces that have been projected ashore. The challenge is to develop a system whereby ships, aircraft, connector vessels, and related systems' capabilities will provide sufficient timely and persistent logistical sustainment

⁸ Conference calls with CAPT Jim Stewart and Mr. Paul Kaskin of OPNAV41, 30 May 2007

⁹ The modeling includes loading of the T-AKE Sea Base shuttle ship at the Advanced Base.

capacity to enable and bring to bear the full set of Seabasing capabilities resident in these systems¹⁰. Sustaining deployed Joint/Combined forces is critical to future successful prosecution of future Joint Combat or humanitarian operations.

1.2 The Sea Based Logistics Problem Definition

The Program Objective Memorandum (POM) developed in 2006 for Seabasing and the associated National Contingency Plan (NCP) first officially identified Seabasing Logistics as a gap in the overall Seabasing Concept¹¹. This gap exists because the traditional sustainment processes and procedures for "blue-water Navy forces" and "green ground Army and Marine Corps forces" are not designed to include support from a sea base. The "blue-water" replenishment process utilizes the Combat Logistics Force (CLF) to transport sustainment directly to naval platforms at-sea. The "green ground force" replenishment process utilizes Strategic lift to transport sustainment requirements from CONUS to theater seaports and airports. In the future, expeditionary ground forces employed from the sea base (prior to access to Sea Ports and Aerial Ports of Debarkation (SPODs and APODs)) will need to be sustained by the sea base which requires the sustainment needs of those forces ashore to also be transported directly to the sea base through the use of three T-AKE ships shuttling supplies from the Advanced Base to the Sea Base at distances up to 2,000nm. T-AKE with remaining sustainment supplies will remain on station at the Sea Base to issue supplies on a pull basis from the deployed Joint forces.

The currently programmed CLF fleet is sized to support the sea-based consumption of CSGs, ESGs, SSGs and LCS but not the full consumption of a brigade sized or larger force ashore.¹² The T-AKE CLF ships must be re-designed and adapted to carry all Classes of Supply required by the ground forces in the right mix by class. Within the JOA, the three supporting T-AKE must be capable of selective offload while at-sea, in an over-the-horizon location, without the employment of a land based APOD or SPOD.

The sea base must be able to sustain select Joint ground force operations with the required daily mix of supplies (known as a Day of Supply (DOS)). This must be accomplished with the minimum storage of supplies held ashore, until the combat or humanitarian objectives are achieved or until the situation provides for secure movement of selected support functions ashore. However, the sea base must be capable of sustaining and supporting a Joint forcible entry capable force from the sea for an extended or indefinite period of time depending on the combat and political environment.

SM21 is taking into consideration the evolving Seabasing structure; developing concepts such as Global Fleet Station (GFS), and the potential requirement to support new units and mission areas such as riverine operations. All of these evolving areas are important and could impact the SM21 Seabasing Logistics architecture described in this document. Many of these new concepts such as GFS have been introduced with little detail including the methods to employ. As a result, some concepts and mission areas like GFS were not analyzed or incorporated into the SM21

¹⁰ Seabasing Logistics Enabling Concept, pp 7-8

¹¹ Ibid, p 9

¹² Ibid

analysis or architecture. However, because of the inherent agility of the JDDSP SOS architecture, new mission areas and concepts can be readily adapted.

2.0 STRATEGIC MOBILITY 21 SEA BASED LOGISTICS ARCHITECTURE

SM21 and Seabasing are complementary expeditionary logistical support programs. Both programs focus on providing access to critical deployment and distribution nodes. SM21 focuses on developing dual use¹³ facilities that will assure access to our critical Strategic Ports in time of need, and Seabasing seeks to provide access to foreign theaters of operations when access to land based ports (seaports and airports) are limited by lack of infrastructure or political considerations. Figure 1 depicts the overarching SM21 Enterprise Architecture Framework. The JDDSP SOS is one future capability of SM21. Figure 3 depicts the JDDSP SOS as a node within the JDDE, while Figure 2 depicts how the JDDSP SOS would support Sea Based logistics.

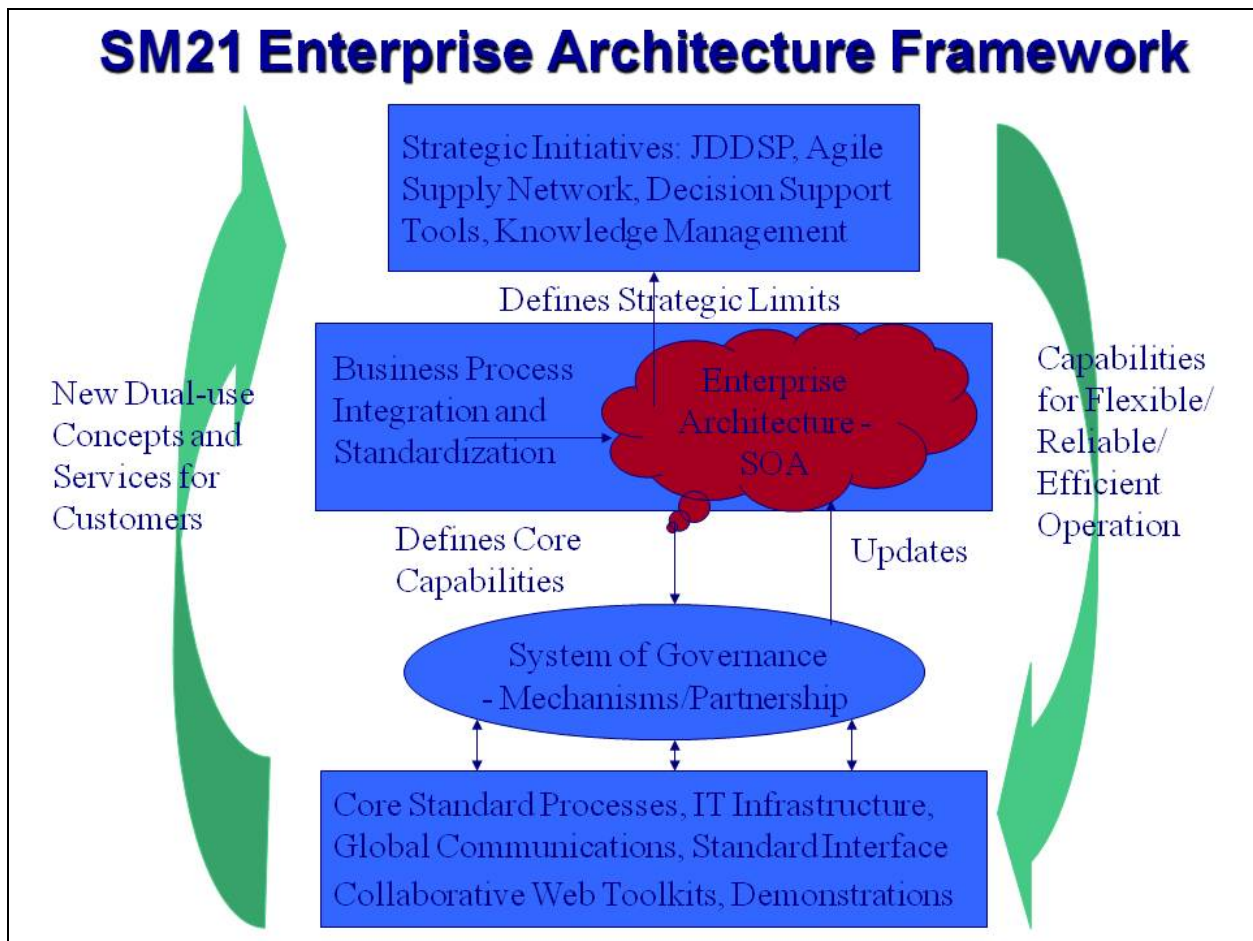


Figure 1 Strategic Mobility 21 Enterprise Architecture Framework

¹³ Dual-use refers to the inherent ability of the system to be used equally well by both commercial and military users.

In Seabasing, the Sea Base (demand and supply node) projects forces ashore (demand) and directly supports and sustains them. The Sea Base will be supported by three T-AKE logistics ships that pull supplies from the Advanced Base (primary operational theater supply node) which could be located as far as 2000nm from the Sea Base. The CONUS is the strategic supply node that serves to support the Advanced Base and Sea Base with initial resupplies.

To set the architecture development in context with the Seabasing environment, it is important to note the importance and difficulty in tracking and handling logistical supplies in this complex environment down to an individual unit order level by national stock number (NSN) or line item number (LIN). Sea based logistics support must be able to track item level shipments through the distribution pipeline as items are consolidated into shipment units, deconsolidated, and transferred between shipment assets and modes of transportation. To accomplish this, Seabasing will need physical and information distribution nodes that are capable of supporting this level of shipment tracking and modal transfer and, when required by changing priorities, modal diversion support. The JDDSP system-of-systems (SOS) physical platform and service oriented architecture (SOA) design includes capabilities such as the In-Land Port -Multi Modal Terminal Operating System (IP -MTOPS) that will incorporate the functional requirements of sea based logistics.

The JDDSP SOS architecture is a set of logistics capabilities which combined provide the required Seabasing Logistics capability. As defined by the Seabasing Joint Integrating Concept, the sea base must be supported by a logistics architecture that can enable responsive, timely, flexible, scalable, noncomplex and survivable sustained support across the full range of military operations in the absence of secure logistics facilities in the Joint Operating Area. The logistics capabilities required to provide timely and persistent resupply to the sea base include (1) Underway Replenishment, (2) Improved Internal Cargo Handling, (3) Enhanced Prepositioning Afloat with Selective Offload, (4) Joint In-transit Visibility/Total Asset Visibility, (5) Logistics Command and Control, (6) Sea based Maintenance, (7), Joint Intermodal Packaging, (8) Time Critical Resupply and (9) Open Ocean Interface and Transfer.

Since Seabasing creates a new operating environment for sustainment operations, various Joint service concepts for the Sea-Base have been developed and will be reviewed during the course of this program. However, in addition to the concepts currently under development, capability gaps remain and will require new research and development to close those gaps. The SM21 - JDDSP system of systems architecture concepts overviewed in the following section and in Figures 1 and 2 can be employed directly by the Sea-Base or can be adapted by adding additional required services to interface with the Sea-Base. This support flexibility is being built into the SM21 Sea Based Logistics Architecture through the SOA and Agile Product Development techniques. SM21 will conduct an experimentation and demonstration campaign for Sea Based logistics operations to support the identification and closing of capability gaps. The following sections define the operating environment supported by the SM21 Sea Based Logistics Architecture.

2.1 The Operating Environment Supported

Sea based operations will be characterized by more rapid and decisive operations, capitalizing on concepts that might be foreign to some elements of the Joint Force. Concepts such as Operational Maneuver from the Sea (OMFTS), Ship to Objective Maneuver (STOM) are not

concepts commonly employed by Army forces. However, Sea based operations will also support the concept of Distributed Operations, which is a relatively common concept for all Joint force elements. Deployed forces supported by the sea base may be highly dispersed and operate in a non-contiguous terrain in an anti-access environment. The possibility exists that there will be multiple Joint Force entry points and longer lines of communication caused by lack of ports and supporting infrastructure in the JOA.

The current Seabasing Joint Integrating Concept and Seabasing Logistics Enabling Concepts state that the sea base must be able to operate at-sea in a JOA up to 2,000nm from a supporting Advanced Base¹⁴. With only three supporting T-AKE planned as supply shuttle ships between the Advanced Based and the Sea Base, this physical separation becomes a critical system architecture design consideration.

2.1.1 The Advanced Base

An Advanced Base is the primary transshipment point for all Classes of Supply required by the Joint forces ashore, which are supplied through the Sea Base. The Advanced Base would maintain a buffer stockpile of required supplies according to the type of operations the Joint forces are supporting. A fully capable Advanced Base should support the delivery of the required days of supply (DOS) throughput. The supplies would be delivered to an advanced base by both commercial and government ocean shipping. This will require the advanced base to have a deep water ocean terminal and military or commercial airfield with sufficiently sized Maximum-On-Ground (MOG) capability for airlift. Additional required logistics infrastructure includes petroleum storage tanks, container marshaling yards, ordnance magazines, cranes, trucks, barges, and a marshalling area for personnel. The infrastructure and support equipment must be available in the correct numbers/sizing to support the DOS demand, unit equipment deployment, and personnel throughput.

The Advanced Base would provide the required space for efficient container sorting, storage, and cargo trans-loading consolidation that would not be allowed in the constrained T-AKE shipboard environment. Additional missions of the Advanced Base include reverse logistics support for retrograde shipments, hazmat disposal, and salvage operations.

¹⁴ Seabasing Logistics Enabling Concept, p 13

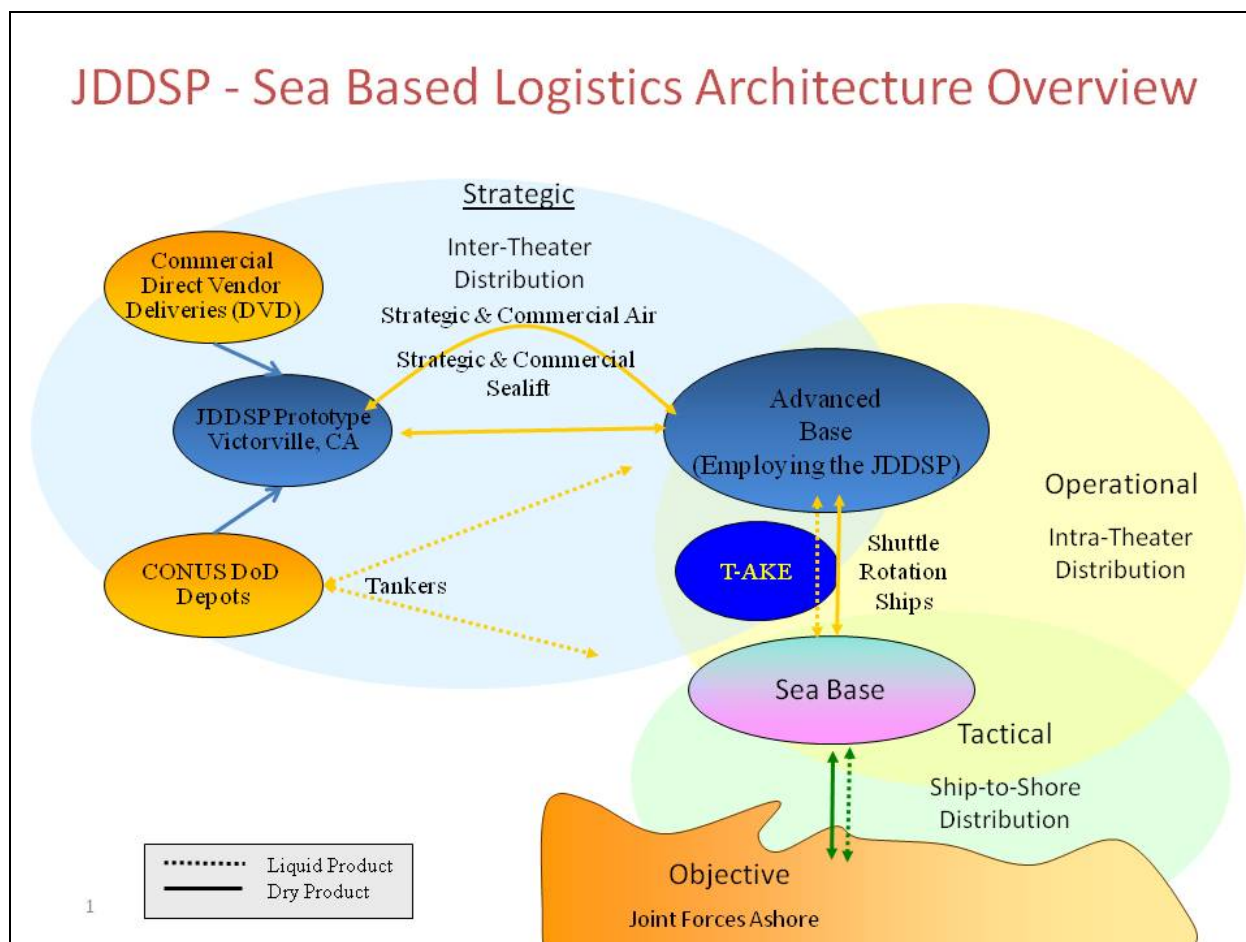


Figure 2: SM21 JDDSP - Sea Based Logistics Architecture Overview¹⁵

2.2 Joint Deployment and Distribution Support Platform Overview

The Strategic Mobility 21 project has a broad scope but at its core focuses on the JDDSP as a transitional node for commercial and military shipments. As a “super-node” connected to the commercial global logistics network and the military Joint Deployment and Distribution Enterprise (JDDE), the JDDSP serves both the physical domain and information domain functions needed to support the Sea-base. The JDDSP can also be defined as an inland port and military component of the Agile Port System (APS) concept developed by CCDoTT¹⁶.

The SM21 vision for the JDDSP in its role of supporting sea based logistics follows:

The JDDSP serves as the single most critical support node for transporting material and personnel to the Sea-Base. It is the storage buffer that enables peak surge flows to the Sea-base. The JDDSP is one in a network of enablers that makes the steer in Texas flinch when the warrior in Iraq is hungry for steak.

¹⁵ Seabasing Logistics Enabling Concept, OPNAV-42 Out-brief, 25 October 2006

¹⁶ SM 21 Initial Capabilities Document, Contractor Report 002, July 28, 2006

The JDDSP control system, which would enable this ambitious vision, will be defined by a system-of-systems architecture currently under development through the experimentation campaign. The JDDSP information management architecture concept currently includes IP-MTOPS, developed using a Service Oriented Architecture (SOA), or inland port operating service, with additional services established through the overarching JDDSP SOA. The JDDSP SOA will provide the JDDSP with the capabilities to demonstrate unprecedented control over movement of goods through the distribution node and in the development of optimized load and movement sequencing plans, which can be dynamically updated. Pre-staged according to load and stow plans, shipments are rapidly on stowed in shuttle platforms (T-AKE), which are connected to the Sea-base. Time-savings, rapid delivery, reduced costs, and increased flow capacity are primary benefits.

Figure 2 provides a high-level representation of the JDDSP within the Joint Deployment and Distribution Enterprise or JDDE. The JDDSP concept can support sea based logistics both as the inland port component of the Agile Port System and as the operating system for advanced bases. As depicted, the JDDSP is an information fusion support node supporting the JDDE organizations including the Combatant Commands, Services, United States Transportation Command (USTRANSCOM), Joint Forces Command (JFCOM), the Defense Logistics Agency (DLA), and commercial industry. As an integrated node in the JDDE, support would be provided for deployment, distribution, retrograde, and reset¹⁷ requirements. The JDDSP would directly support shipments using military and commercial sea and air lift. The JDDSP reference architecture can be adapted for use at in a wide range of commercial and military applications including logistics air and sea terminals, military advanced bases, which would be in support of a sea base, or intermediate staging bases (ISB) supporting other JOA. Many of the JDDSP concept functions are similar to those functions performed by advanced bases and ISB. Convergence of mission threads, activities, and systems in support of those activities can be anticipated. Efficient operation of the end-to-end global logistics network, along with the individual network nodes, is enabled by information technology. The SM21 SOA framework can be employed to provide information domain support for most deployment and distribution nodes. The information domain serves modeling and simulation purposes as well as full-time information support during all phases of the project.

Capabilities -- mission threads -- activities -- systems and networks culminate in the execution of a physical mission. Throughout the development and future demonstration phases of the sea based logistics project, activities in the information domain will directly impact activities in the JDDSP physical domain.

¹⁷ Reset is a generic term that refers to a series of actions to restore units to a desired level of readiness given mission requirements and availability of resources.

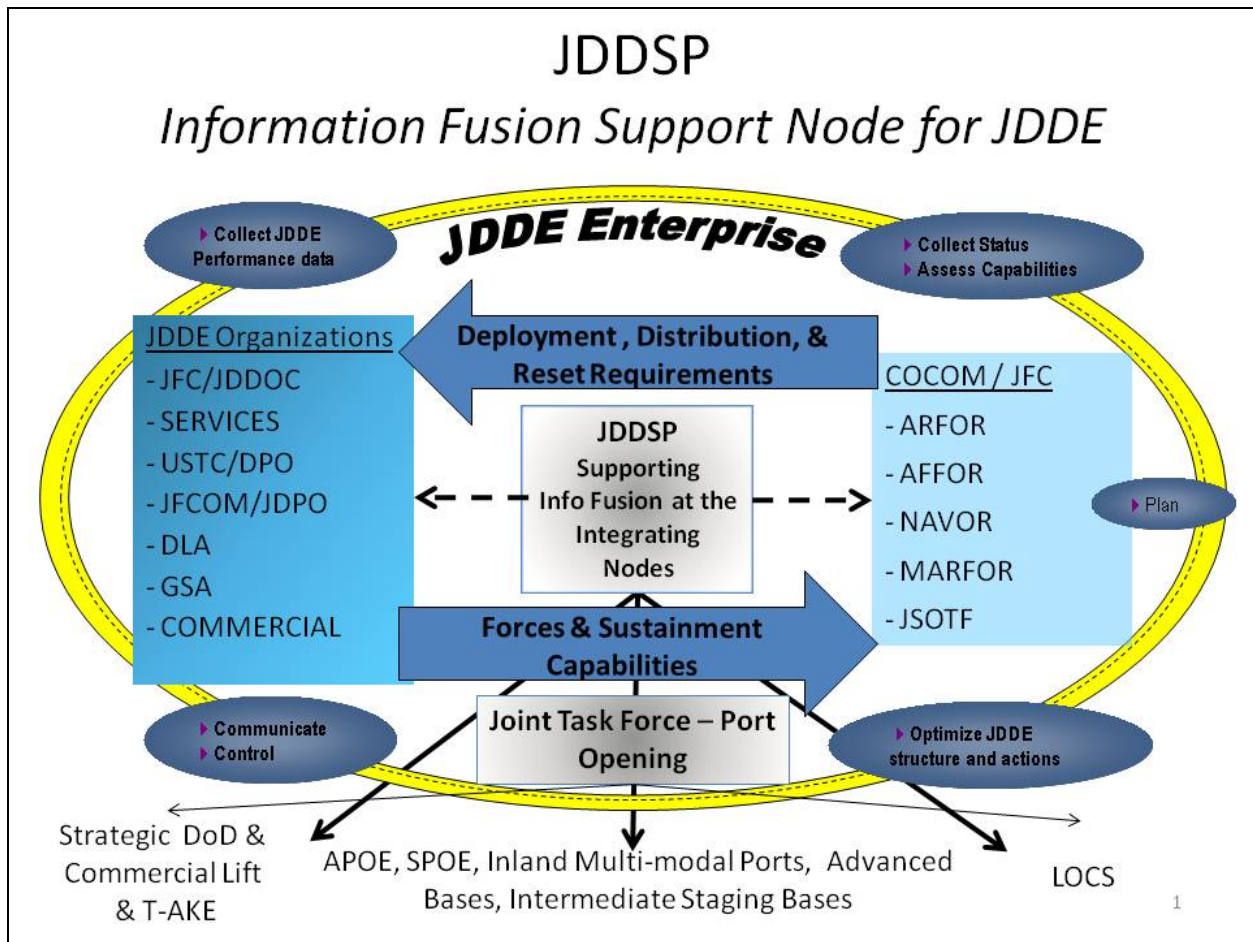


Figure 3: Joint Deployment and Distribution Platform

2.2.1 The Inland Port - Multi-modal Terminal Operating System (IP MTOPS)

IP MTOPS is a software concept design to support facilities and operational process functions of the JDDSP¹⁸. It is one of the systems that compose the JDDSP SOS. IP-MTOPS is designed within the framework of the SM21 Service Oriented Architecture (SOA). The IP-MTOPS concept is designed to optimize logistics flows, assist tenants in maintaining productivity, provide high quality customer service, and strengthen visibility of shipments and shipment processing times through the physical domain of the JDDSP. IT-MTOPS is supported by an SM21 designed Integrated Tracking Service (ITS)¹⁹ that provides the required services to manage incoming and outgoing freight flows through a distribution node. IT-MTOPS will be accessed through a Web Portal that will provide access to all of the JDDSP C2 tools and operational pictures.

¹⁸ In the Sea Base context, SM21 considers the JDDSP concept supporting both the CONUS regional inland port within the context of an Agile Port System and as the Advanced Base distribution system.

¹⁹ The Integrated Tracking Service was formally named the SM21 Integrated Tracking System. However, since the completion of the Independent Validation, and Verification, the SM21 information management system architecture has become SOA centric requiring the conversion of the ITS to a service design.

IT-MTOPS will ultimately provide tools to manage the inland logistics port processes listed below and as depicted in Figure 4:

- Inventory Management,
- Shipping Order Management,
- Yard Operations,
- Highway Operations,
- Rail Operations,
- Airlift Operations,
- Warehouse Operations,
- Sealift Planning,
- Accounting,
- Notifications and Alerts,
- System Reports,
- Integration and Technical Requirements.

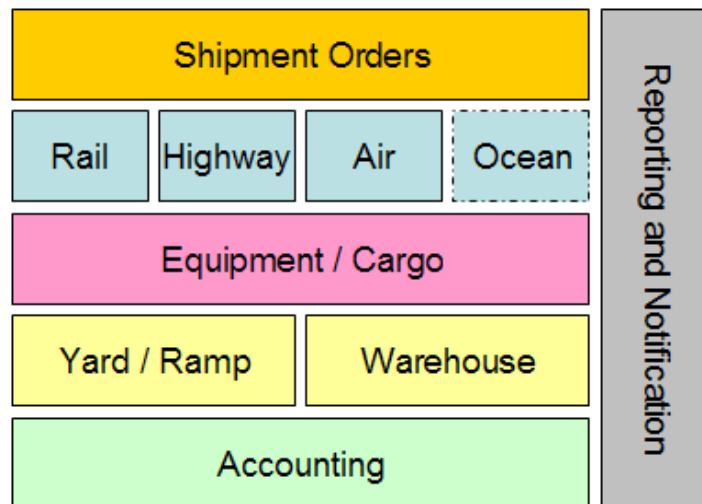


Figure 4: IP-MTOPS Objective Capabilities

The IP-MTOPS will manage the exchange of structured and unstructured data provided by best of breed commercial freight and asset management software systems employed for moving freight into, out of, and within the JDDSP. The IP-MTOPS services will be adapted to the physical domain it is being employed such as a hypothetical advanced base on Guam. Collectively these external and internal facility/information services provide the information necessary for the IP-MTOPS to perform the manipulation, temporary storage, retrieval, transmission and presentation of actionable information. The primary IP-MTOPS function is to provide the timely, actionable data needed by decision makers to manage terminal, inland port, and advanced base operations.

The IP-MTOPS will be focused on providing actionable data to support the functional, business processes associated with the physical flow of transportation assets, cargo, and personnel. The IP-MTOPS concept supports the requirements of both military and commercial shippers utilizing a transshipment node within the JDDE or commercial distribution network. The system is being

designed to support the throughput of shipments via a single mode but will also support modal diversions and shipment trans-loading operations for both import and export shipments.

2.2.2 Transportation Load Planning Services

Currently the DoD employs the Integrated Computerized Deployment System primarily for stow planning ships. In recent years USTRANSCOM has explored the possibility of extending the system to a “single load planning” tool for all modes of transport. SM21 is exploring the use of ICODES to provide load planning services to the Service Oriented Architecture (SOA) and extend the single load planning concept by integrating load planning services employing intelligent agents, shipment optimization algorithms to enable dynamic re-planning of en-route shipments. As with other functional requirements, SM21 will explore the best of breed system to provide integrated load planning services to assist operators in the staging of cargo in marshalling yards, the load-planning of cargo onto multiple conveyance types (i.e., trucks, railcars, and ships), and to support the optimized planning and dynamic re-planning of delivery functions. This would include planning the diversion of shipments along alternative surface routes and air channels.

ICODES was used by the joint SM21-CCDoTT SBLO team to stow plan the T-AKE in an effort to determine the maximum number of the recently designed Joint Modular Intermodal Containers (JMIC) that can be effectively loaded on each shuttle ship between the Advanced Base and the Sea Base. Potentially ICDOES will be employed as the ship stow planning service within the SM21 SOA; however, ICODES would need to be integrated as a stowage planning service and not as a standalone system. The selected best of breed load planning service along with the SM21 optimized load planning algorithm will enable the development of optimized T-AKE load sequence plans. These plans are necessary to meet the required two day T-AKE loading time. Currently, the CLF T-AKE ships are loaded over a six to eight day period, which would not be meet the required two day loading of the T-AKE for supporting the Sea Base supply shuttle mission.

The *Integrated Computerized Deployment System (ICODES)* is being considered by SM21 as a load planning system because it is currently used by DoD and would fit the SOA development strategy of first attempting to adapt existing systems. The second reason for considering ICODES is for its set of logistic software tools for conveyance stow-planning that utilizes intelligent software agents in a human-computer collaborative mode. As an example of a new generation of ‘information-centric’ military decision-support systems, ICODES includes expert agents with automatic reasoning and analysis capabilities. This is made possible by an internal virtual representation of the load-planning environment, in terms of conveyance and cargo characteristics and the complex relationships that constitute the context within which load-planning operations are performed. ICODES agents monitor the principal determinants of cargo stowage, including: the placement and segregation requirements for hazardous cargo items; the trim, list, stress, and bending moments of ship structures; the accessibility of stow areas through ramps, cranes, elevators, hatches, and doors; the correct placement of cargo items in respect to fire lanes, no-stow areas, reserved stow areas, and inter-cargo spacing tolerances; and, the accuracy of cargo characteristics (e.g., dimensions, weight, type, and identification codes) relative to standard cargo libraries and associated reference tables.

In addition, ICODES includes the *JINNI* module that allows users to create staging areas and marshalling yards, giving ICODES the ability to support load-planning operations in the broader spectrum of tracking cargo through the deployment stages of assembly, staging, load-planning, and the rearrangement of load-plans during transit.

ICODES currently interfaces with the World-Wide Port System (WPS) for Army force deployment and re-deployment planning operations. However, it is also capable of interfacing with the Transportation Coordinators' Automated Information for Movement System (TCAIMS-II) although this interface is seldom exercised. Additionally, ICODES interfaces with the Marine Air-Ground Task Force (MAGTF) Deployment Support System (MDSS-II), the Integrated Booking System (IBS); TRANSWAY (for route planning); and, the proposed Joint Forces Collaborative Toolkit (JFCT) for sea-basing operations.

3.0 OPERATIONAL ANALYSIS

To understand the operational requirements that the JDDSP would support within CONUS and at the Advanced Base as defined in paragraph 2.1.1 above, the basic operational principals of the Sea-Base, the JDDSP, and developments in current deployment and distribution doctrine were analyzed. The systems associated with the operational environment are reviewed again and analyzed in the following sections. A review of the joint SBLO study analysis is provided as a final section of this Operational Analysis section.

3.1 Sea-Based Logistics

The sea base as an operating entity is an inherently maneuverable, scalable aggregation of distributed, networked support platforms that enable the global power projection of offensive and defensive forces from the sea. The sea base concept includes the ability to assemble, equip, project, support, sustain, and redeploy those forces without reliance on land bases within the Joint Area of Operations.²⁰

Critical to the Sea-Basing concept is the integration associated with the following systems –

- Information and C² systems
- Inter-ship cargo transfer systems
- Intra-ship material handling systems
- Sea-Base to shore operations systems
- Intra theater operations systems
- Inter theater operations systems.²¹

There are two primary documents that have been used to develop the JDDSP support requirements for Seabasing: the Seabasing Joint Integrating Concept and the Seabasing Logistics Enabling Concept. Both documents provide the base requirements for sea based logistics support. Because SM21 maintains a system of systems perspective, it is important to understand that Seabasing is a complex system of systems itself as described in the aforementioned documents. SM21 is concentrating on the logistical support requirements of employing the Joint

²⁰ <http://www.dtic.mil/ndia/2004expwarfare/siknner.ppt>

²¹ Ibid.

Force described for our development purposes as consisting of a Marine Expeditionary Brigade (MEB) and an Army Brigade Combat Team (BCT). SM21 has considered how information technology (IT) and command and control (C²) systems would support deployment and distribution operations. SM21 has also researched and analyzed what cargo handling and packaging materials would best support inter-ship transfers and intra-ship material handling requirements and how they would be optimally employed.

3.1.1 Overview of Potential JDDSP Sea Based Logistics Support

The JDDSP is designed as a dual use capability to foster greater collaboration between military and other strategic port users, thus assuring access to strategic ports in times of national crisis involving surge deployment operations²². As part of efforts to look at future force projection operations, SM 21 has interests in other force projection concepts that may benefit from SM21's research, concept development, and experimentation, or may provide insights to common areas of interest. Sea-Basing is one such concept.

The JDDSP design includes planned support for seamless sea based supply chain management and inventory control. This requirement was outlined by the Defense Science Board Task Force on Seabasing in 2003:

Logistics and operations must be merged into a single, flexible capability responsive to commanders needs...Achieving both interoperability and inter-modality transfer demands a seamless, rapid and efficient design that is fully joint.

The ability to collaborate on the distribution of sustainment shipments will enable the JDDSP to effectively support expeditionary forces through in-transit shipment management including: shipment reconfiguration, consolidation, temporary storage as buffer stock, and modal diversion to match changing requirements at both the CONUS JDDSP, such as at the Southern California Logistics Airport, and the Advanced Base JDDSP nodes. When the JDDSP support systems are employed at an Advanced Base, a primary distribution support function will be stow and optimized load sequence planning for the T-AKE. The planned development of the JDDSP "Smart Loading" capability will enable dynamic optimized load planning based on the calculated discharge sequence requirements of the T-AKE shuttle vessels. This concept is overviewed in the following sections. Sea base support will require the receipt and aggregation of materials and equipment at an advanced base for reconfiguration and loading on T-AKE shuttle ships for demand based discharge to Joint Forces ashore. The Smart Loading capabilities of the SM21 SOA are being designed to support this requirement.

3.2 JDDSP - Sea Base Support Concept Integration

This section discusses the most significant support capabilities the JDDSP can provide to the Sea Base. These support areas, in conjunction with the suggested areas for Demonstration and Experimentation from the Joint Logistics (Distribution) Joint Integrating Concept (JL (D) JIC), were used to develop potential elements for the SM21 experimentation campaign plan.

²² For greater discussion of JPPSP operational concepts and capabilities, refer to: SM 21 Initial Capabilities Document, Contractor Report 002, July 28, 2006

DoD transformation is assuming a greater interdependence among the services, as modular Joint Expeditionary formations will be the forces projected to meet overseas military obligations.

The Army, in most situations will provide the majority of the logistical support infrastructure assets, and therefore, their Theater Support Command (TSC) will provide the backbone for joint logistics C2 infrastructure. The TSC or its smaller counterpart, the Expeditionary Support Command (ESC), provides the fusion cells to control distribution management in theater and synchronization and reach back to national providers. The TSC/ESC is linked to the national sustainment base through the Army Sustainment Command (ASC), which will be the logistical support command to FORSCOM. The ASC integrates logistics with service and strategic partners.²³

Paralleling the TSC/ESC organization dealing with the fusion of transportation and distribution operations is the Joint Deployment and Distribution Operations Center (JDDOC) developed to synchronize the flow of strategic lift assets into theater.

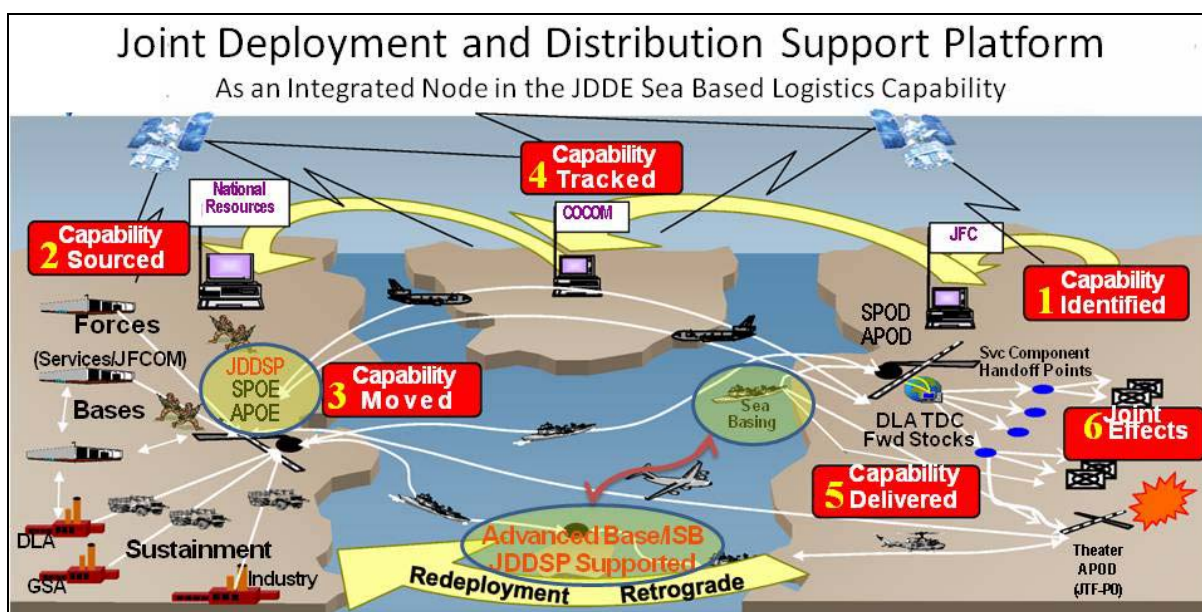


Figure 7: JDDSP: An Integrated Node in the JDDE

The CONUS link, the Joint Deployment and Distribution Enterprise (JDDE)²⁴ concept is articulated in the JL (D) JIC. The JDDSP is designed as a JDDE type node in CONUS and at the Advanced Base to perform the JDDOC function of synchronization at the point of departure (See Figure 7 above). It is envisioned to be an extension of the JDDOC. The JDDSP is envisioned to

²³

<https://www.cascom.army.mil/private/TD/Multifunctional/TSPs/TSC/Theater%20Sustainment%20Command.ppt>

²⁴ The JDDE is:...an integrated system consisting of assets, materiel, personnel, leaders, organizations, procedures, tools, training, facilities, and doctrine – will provide logistics solutions to the JFC to minimize seams in the pipeline that characterize current strategic and theater distribution segments. The JDDE will complement, interact with and augment Service or JFC-unique distribution responsibilities and capabilities. Joint Logistics (Distribution) Joint Integrating Concept Version 1.0, The Joint Staff, Feb 6, 2006 pg i

be a reach back source at the point of execution available to the JDDOC to effect dynamic changes in the deployment and distribution flow as requirements change.

Given the influence of transformational activities and strategic direction, the relationship between the JDDSP and Sea-Base would likely be as described in the following paragraphs.

The JDDSP can perform the functions of a JDDE type node. The JDDSP is an interdiction point to identify and divert shipments whose addresses (unit locations) have changed, whose priorities have changed (need to expedite, such as change from sealift mode to airlift mode), or to reroute as transactions change delivery priorities or destinations. In this sense, the JDDSP would perform Vendor Managed Inventory functions. The JDDSP responds to the needs of the warfighter and packages movements of supplies to meet those needs, as opposed to merely fulfilling requisition instructions.

The primary mission of the JDDSP is designed to validate and assure deployment and distribution is properly captured and entered into the appropriate IT support systems. The JDDSP's distribution function would, on a routine basis, be replenishing forward stocks issued to meet emergency needs. The JDDSP would serve as the buffer to collect materials for shipment, organizing them in accordance with warfighter priorities, and smart loading lift assets to minimize handling needs as materials flow forward. The JDDSP provides the facilities and information fusion capabilities to manage inventories as they depart CONUS in support of active military missions.

Additionally, the JDDSP, with abilities to locate and pull stock under its control, provides a location with capabilities to divert shipments from one mode of transport to another or from one destination to a new destination, and do all the supporting transactions to maintain accountability within the deployment and distribution system.

The Sea-Base, by its nature is a distribution hub. It is designed to minimize the need for storage of materials forward on land in the theater. The focus is to manage the distribution of sustainment from the Sea-Base or directly from the Advanced Base. By design the JDDSP is suited to support the flow of sustainment through network outlined in Figure 8 below.

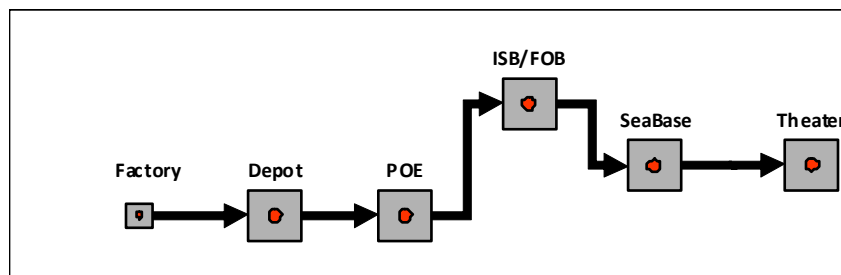


Figure 8: Sea Based Distribution

3.3 Joint Sea Based Logistics Optimization (SBLO) Analysis

The Joint SM21 and LMI SBLO study conducted data collection planning and data collection execution during the first two months of the study. Most of the data used in the SBLO study

were gathered from a wide range of sources, but the primary stakeholders—Marine Corps and Army—provided most of the data:

- The Marine Corps Combat Development Command provided the Marine Corps data, which consisted of the most recent iteration of the 2015 MEB as part of the Marine Prepositioning Force (Future), or MPF (F). It also provided were the projected sustainment factors for the 2015 MEB.
- The Army Training and Doctrine Command and the Combined Arms Support Command (CASCOM) provided the Army force data. The consumption factors for the various force constructs were standard Army consumption factors approved by CASCOM.

The Marine Corps provided only one force construct (2015 MEB) for this study. The MEB was broken down into various echelons, while the Army provided several different force constructs from an Infantry Brigade Combat Team (IBCT) to a Heavy Brigade Combat Team (HBCT). Previous Navy studies only used one Army force construct: an IBCT. The Army believed that it was important to provide force constructs that would actually be used in the various scenarios, plus the required sustainment forces.

3.3.1 Days of Supply Requirements Analysis

The initial step in the requirements analysis was to conduct an impartial and comprehensive analysis of the sea base's initial DOS requirement. The significance of this analysis is that the DOS loaded on the three T-AKE vessels designated to shuttle supplies to the Sea Base must support both the employment and sustainment requirements of the engaged joint forces until the sustainment pipeline is in place. For the analysis, the study team accepted as the baseline the 45 DOS requirement aboard the Maritime Prepositioning Force Future (MPF (F)) squadron designed for the 2015 Marine Expeditionary Brigade (MEB).

The primary research questions was - is the MPF (F) DOS sustainment on three T-AKEs sufficient to support a joint force ashore until the sustainment pipeline from the sources of supply is in place and capable of delivering sustainment to either the advanced base or directly to the sea base. The goal was to determine if there was residual sustainment available for other joint forces (how much and for how long) since the baseline was focused on Marine Corps only support.

Based on research into sustainment planning by the SBLO team, it was determined the use of the Services' metric of pounds-per-person-per-day to compute daily sustainment requirements was required. The issue of collecting higher fidelity data through actual demand record data collection methods should be explored in follow-on SM21 supported SBLO studies.

3.3.1.1 Approach

In conjunction with the study stakeholders, it was determined that the DOS requirements would be based on the 2015 MPF (F) MEB and other joint forces as per the study scenarios (primarily Army Brigade Combat Team (BCT) forces plus required Army sustainment forces).

The distribution requirement of consumables from the three T-AKEs to the ground forces ashore were then modeled and analyzed. The daily consumption requirements by class of supply for

supported forces were determined and intensity levels of activity as described in each scenario were determined. Four intensity levels were developed as follows: not committed, light, moderate, heavy, and reserve. Collectively, these consumption factors produced DOS requirements for the MPF (F) and Army BCT forces.

The consumption factors were given by the Service stakeholders in the pounds-per-person-per-day metric and did not reflect any improvements in Service sustainment planning. The study also obtained data from DOD, Service, and other organization's officially recognized open source documents. Some air and surface "connector" capabilities and specifications were obtained from commercial sources on company Web sites or from marketing brochures. Although the data used in the study was current, it is perishable and will require periodic updating to maintain its validity within the context of the study or follow-on SM21 experimentation. Consideration is being given by SM21 to develop a Sea Based Logistics knowledge management system that could be made accessible in an unclassified environment for "idea" collaboration between government, academic, and commercial entities.

3.3.1.2 Scenario Development

Three unclassified Defense Planning Scenarios, Humanitarian Operations, Combat, and Major Combat, were developed for the analysis with each having multiple excursions of various force constructs and intensity levels. While the Marine Corps has a very detailed Seabasing CONOPS, the Army does not. Under certain scenarios, the Army forces had to be portrayed in accordance with the intent of the Seabasing JIC because it was the best source of information at that time. Army force constructs provided by CASCOM were also considered as well as forces extracted from the Steady State Security Posture (SSSP) vignettes for the Operational Availability 2008 study. The SSSP has five strategic environments or future themes, from which to form a basis for demand over time, and has developed or is developing a menu of different surge-inducing events to overlay on those Steady-State demands. The Operational Availability 2008 study is the Department's first comprehensive look at the revised Force Planning Construct. The SBLO intensity levels established were not linear (one intensity level over the course of the scenario); instead the intensity levels were varied by how an operation would be conducted. This approach showed the operational tempo (OPTEMPO) "peaks and valleys" associated with real-world operations.

3.3.1.3 Commonality of Supplies Explored

As described earlier, the loading of three T-AKEs was explored as part of the MPF (F). The study team found that the Marine Corps has detailed plans for how it would load the sustainment for the 2015 MEB aboard the three vessels. The Marine Corps' sustainment fills the three T-AKEs, so there are no plans to load these ships with specific sustainment to support a joint force; therefore, all available supplies would need to be "generic" to permit use by any Service. Examples of generic supplies include Class I (food and water), Class III (fuel), and Class V (ammunition). To obtain a sense of the level of commonality for other classes of supply between the Marine Corps and Army, the SBLO study examined requisition data from Operation Iraqi Freedom (OIF) for 2006.

Repair Parts: This analysis was intended to be only a snapshot of commonality of Class IX (repair parts) between the Marine Corps and the Army. Clearly, more detailed analysis is warranted.

It is noteworthy that approximately 10 percent of the Class IX items were common (had the same national stock number) to the Marine Corps and Army. Those items accounted for 40 percent of all requisitions, and made up 68 percent of the tonnage for the repair parts shipped, equating to 30,120,443 “items” or 59 percent of all items shipped. The conclusion was reached that these data are indicative of the commonality of support available from a sea base to joint forces and a good indicator of activity and workload associated with support of a joint force. Commonality of supplies is clearly worthy of further study.

Ammunition: The study also examined Class V (ammunition and explosives). It was not as easy to compute the commonality of ammunition requisitions without some detailed analysis of the Department of Defense Identification Code (DODIC), a four-digit code assigned by the Defense Logistics Services Center that identifies ammunition and explosive items. It was determined that between 2002 and 2006, Marine Corps and Army requisitions totaled 68,234 ST. The tonnage of ammunition that was common to both Services was 23,109 ST, or approximately 34 percent. This result has no particular significance because the Army has a larger presence in both theaters. Based on these findings, it was concluded that if T-AKE loading was to be designed to support a joint force, it would be necessary to investigate the composition of the ammunition stocks in more detail.

3.3.1.4 Findings and Recommendations

The findings and recommendations associated with the days of supply requirements analysis are summarized below:

- Findings:
 - Previous Marine Corps and Navy analyses did not include Army sustainment forces needed to support the Army combat forces.
 - Army Seabasing CONOPS is in draft form.
 - Marine Corps and Army appear to share little commonality in sustainment supplies.
 - The pounds-per-person-per-day sustainment calculations may not be appropriate for today’s adaptive planning environment.
- Recommendations related to SM21 Sea Based Logistics support:
 - After more complete data is available on Army sustainment force requirements, recalculate the impact on sustainment distribution in a sea based logistics environment.
 - Once the Army completes its Seabasing CONOPS, SM21 should evaluate sea based logistics support using the revised sea based logistics support requirements.
 - Complete a more detailed analysis of the level of commonality in sustainment stocks between the Marine Corps and Army relative to operations in a Seabasing

- environment; potentially add stocks to the T-AKE load out to accommodate the needs of a joint force.
- Support an OSD- Joint Staff led effort to update the policies and procedures for sustainment planning and replace the pounds-per-person-per-day sustainment calculations with a method based on actual consumption data from current and relevant past operations.
- Support a Joint Staff initiated distribution study to look at surface distribution of sustainment from Mobile Landing Platforms and Landing Crafts Air Cushioned forward and aerial distribution directly from the sea base to consuming units. This is necessary to complete the end-to-end distribution analysis.

3.3.2 T-AKE Employment Analysis

The SBLO joint study team concluded that the best approach for evaluating T-AKE employment options was to initiate several concurrent actions. To establish a knowledge baseline, a broad range of studies completed by the Joint Staff and Services were reviewed to determine the currently defined logistics capabilities for supporting joint sea-based forces in the 2015–2025 timeframe. Subject matter experts were interviewed to obtain additional details associated with the sustainment capabilities being pursued by the Services. The team also collected and studied all available models and associated studies of sea-based sustainment operations. This information provided the required insight to potential capability gaps between Service sustainment requirements and existing T-AKE sustainment support capabilities and established the basis for the T-AKE employment options study.

The objective of the SBLO joint study was to assess the ability of the T-AKE to support the delivery of sustainment stocks from the advanced base to the sea base via continuous shuttle missions. The advanced base is central to the support of the sea base because it is the primary warehouse and transshipment point through which the majority of all supplies needed by the sea base will pass. The sea base is the primary demand node since it supports and sustains expeditionary ground forces projected ashore. However, the critical link between the nodes is the T-AKE, which is used to create a support network of logistics shuttle ships connecting the sea base with the advanced base. The T-AKE is a floating warehouse that remains on station issuing demand based requisitions of all Classes of Supply until stocks reach a pre-determined safety level or out of stock condition. At that point the T-AKE makes the return trip to the advanced base for downloading of remaining supplies and then the immediate restocking of the required mix of sustainment supplies.

Three T-AKE ships will become a part of the Maritime Prepositioning Group (MPG), which has the mission within the sea base to sustain both afloat sea-based forces and the joint forces projected ashore. The forces to be supported ashore include both the MEB and other select joint and combined forces as described previously. The attributes of the T-AKE are provided in Figure 5.

The T-AKE employment options that were considered by the SBLO team focused on: (1) the shuttle mission between the advanced base and the sea base and (2) the sustainment warehouse and distribution function. The T-AKE load sustainment supplies at the advanced base and then

issues the supplies to the Joint Forces ashore. Three sustainment scenarios were used for the analysis: Humanitarian Assistance (HA), Combat, and Major Combat Operations (MCO). The objective was to determine if the assigned T-AKE force of three ships could provide the timely and persistent logistical sustainment support to satisfy the full range of operational scenarios which would enable maintaining minimal logistical footprint ashore.

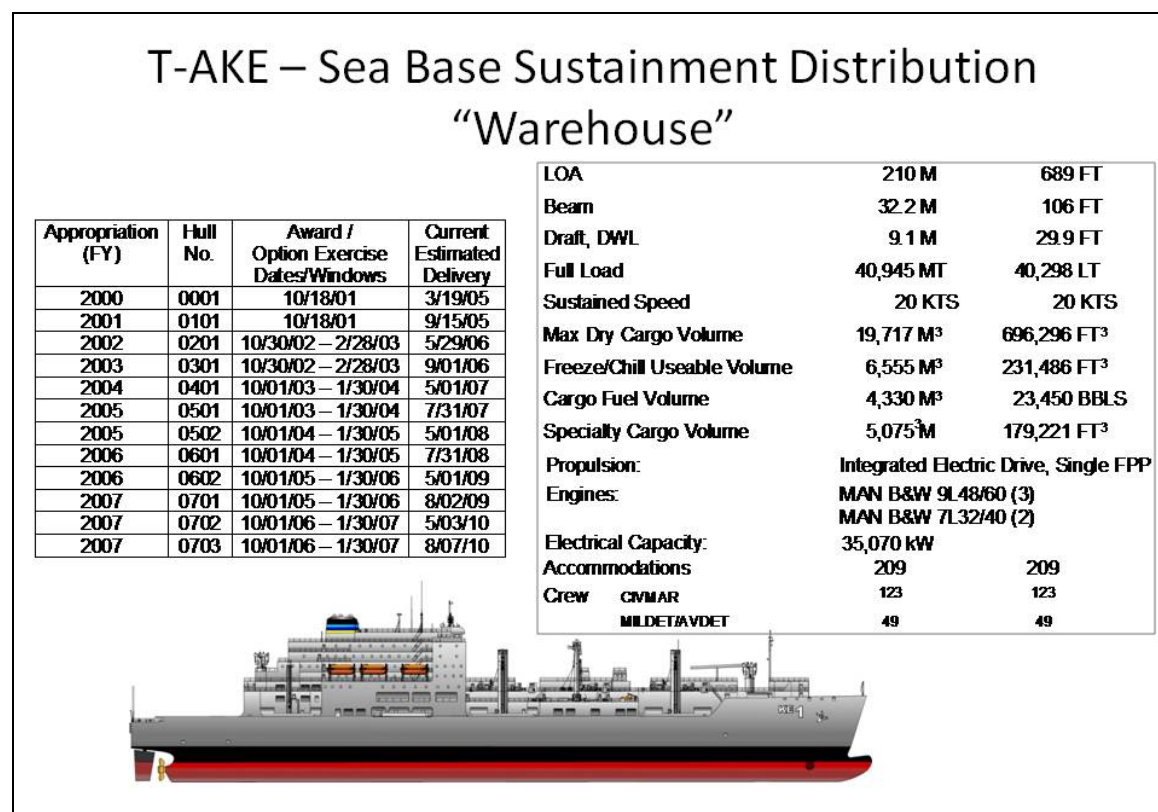


Figure 5: T-AKE – Sea Based Logistics Sustainment Distribution Platform

It is important to note that the T-AKE ships were originally designed to support the Navy Combat Logistics Force (CLF), which traditionally replenish ships at-sea with food, ordnance, and dry cargo. This is a relatively easy mission compared to the much more volatile support requirements connected with a deployed joint force. In this study, we examined the employment of the T-AKE in sustaining ground force requirements through the sea base. Since the sea base concept does not currently include the transfer of 20-foot or larger containers at sea, the sustainment for the sea base must be broken down into breakbulk or modular packaging forms for transfer between the T-AKE and the sea base. It should be noted that the T-AKEs were designed to store and handle QuadCons²⁵. In this study SM21 explored alternative packaging concepts.

In summary, three T-AKEs were employed to serve as the primary logistics shuttle platforms between the advanced base and the sea base. Two Petroleum, Oil, and Lubricant (POL) shuttles

²⁵ Seabasing Logistics Enabling Concept, Annex: Modeling, Methodology, Assumptions, Analysis, Results, and Conclusion, December 2006, p. 28.

(Auxiliary Fleet Oilers (T-AOs) and commercial tankers) were assigned to support the Class III sustainment requirements for all forces supported by the sea base. The objective was to determine if the T-AKE could support the full range of operational scenarios from HA to MCO enabling the reduction of the logistical footprint within the Joint Operational Area (JOA).

3.3.2.1 Assumptions

The initial analysis completed was based largely on a volumetric study completed by Naval Sea Systems Command (NAVSEA), which determined that the stowage capacity of the T-AKE was 7,364 Joint Intermodal Modular Containers (JMICs). Figure 8 provides a depiction of the JMIC. The NAVSEA study used the Cargo Arrangements and Routing Program (CARP)²⁶ offload model to complete the analysis. Each JMIC in the study was loaded to an average gross weight of 2,344 pounds. Since the JMIC has an average tare weight of 300 pounds, each JMIC had an average payload of 2,044 pounds. Using the planning factors established by the NAVSEA CARP analysis and continuous operations, the T-AKE could discharge up to a total of 2,759 ST of sustainment daily for a Joint force ashore when employing the JMIC as the primary packaging system.

The SBLO T-AKE employment analysis was completed in two phases using different assumptions. The initial phase focused on determining the ability of the T-AKE to sustain continuous emergency or surge discharge operations without consideration of operational constraints. During this analysis, three T-AKEs were employed with only a shuttle mission assuming that sustainment could be stored on the sea base until required by deployed forces. For the second phase, analysis was focused on determining whether the required joint force sustainment rates could be supported by the T-AKE in an operational environment without using other assets assigned to the sea base as temporary storage facilities. Three dedicated T-AKE were employed to sustain the sea base operations, including up to two joint brigades operating ashore, for a 45-day period using a secure advanced base 2000 nm from the sea base.²⁷ All sustainment was loaded into the JMIC and underway replenishment (UNREP) operations were supported by one heavy UNREP station and one vertical replenishment station on the T-AKE being discharged.

It was assumed that all three T-AKEs were loaded with the right mix of supplies to support the deployed joint forces required daily sustainment distribution. For the JMIC analysis, the T-AKE sustainment loads did not include bulk liquids (Class III and water). Bulk fuel was assumed to be supplied by T-AOs or tankers. At the sea base, it was assumed that sustainment transfer to the connectors would match T-AKE discharge rates for all phases of the analysis. The following additional assumptions were used during the initial analysis:

- 7,364 JMICs with a weight of 2,344 pounds (2,044 pounds of cargo minus 300 pounds tare weight) could be loaded on a T-AKE
 - 802 JMICs required for afloat force support (800 ST of supply)

²⁶ The Cargo Arrangements and Routing Program/Cargo Flow Simulation (CARP/CFS) model as currently fielded is a detailed T-AKE offload model. However, CARP does not currently support T-AKE load modeling.

²⁷ *Seabasing Joint Integrating Concept*, Version 1.0, August 1, 2005, p. 8.

- 6562 JMICs for support of the combat deployed joint force
- Pier-side loading at the advanced base employed two cranes with an average lift rate of 68.4 JMICs per hour per crane
- Transit speed was 20 knots sustained with an average speed of advance of 17.5 knots during transit time between the sea base and the advanced base.
- Continuous daily discharge cycles were employed as required.

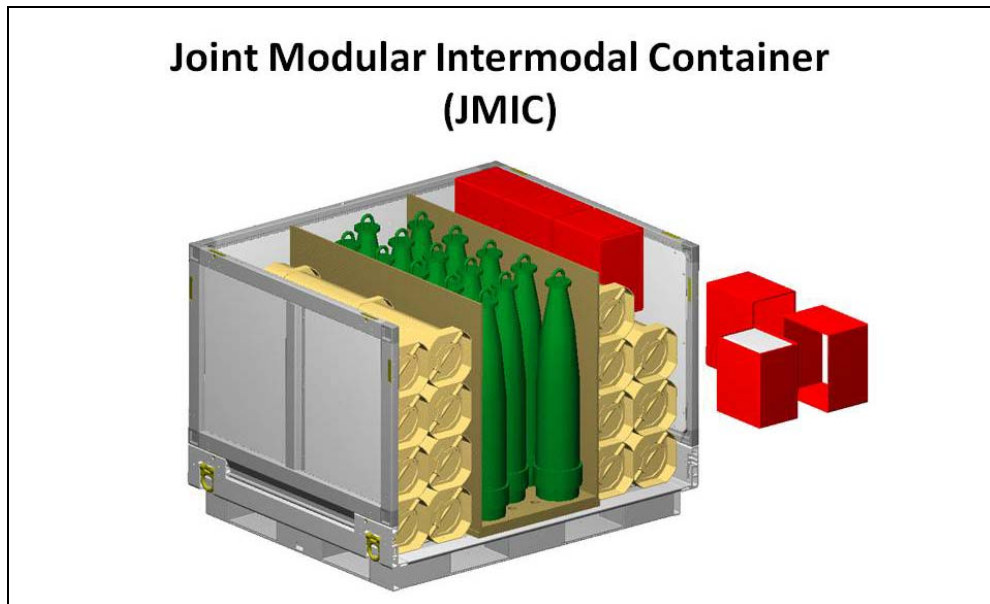


Figure 6: Joint Modular Intermodal Container

3.3.2.2 Modeling Overview

A combination of analysis tools were used to assess the T-AKE employment options. The results were also compared with the Navy sustainment results obtained from use of the Chief of Naval Operations Strategic Mobility/Combat Logistics Division (N42) 42- developed ExtendTM simulation model. The initial SM21 analysis was completed using Excel based models while the SM21 Arena based models were being enhanced for sea based logistics support analysis.

Employing the operational requirements established for the sea base, each T-AKE was required to stay on station at the sea base until the sustainment discharge rates of the operational scenarios could no longer be met and the T-AKE reached a predetermined safety level or an out-of-stock condition for one or more critical classes of supply. The most current T-AKE as-built cargo arrangement drawings were obtained from the Maritime Administration for JMIC (cargo) stow planning. To complete the revised stow plan analysis, the updated T-AKE cargo arrangement drawing was loaded into the Integrated Computerized Deployment System (ICODES) JNNI (ICODES support module) to build the JMIC stow areas. The analysis identified a reduction of 1,476 JMICs in the T-AKE capacity from the initial Navy studies. Therefore, the total JMIC load was reduced to 5,888 on each T-AKE at the advanced base, not the original 7,364 JMICs. The daily discharge operations were restricted to 12 hours per day. The restriction to 12 hour discharge operations did not have an impact on supplying the required sustainment ashore.

The following are the T-AKE load factor assumptions employed for the analysis:

- Maximum volumetric capacity was 5,888 JMICs per T-AKE shipload
- Each JMIC was loaded to an average weight of 2,632 pounds
- Cargo mix matched hold arrangements
- Selective offload was possible
- Average UNREP rate employed was 112.5 JMICs per hour
- DOS requirement for selected scenarios was used to plan daily workload.

After completing the scenario and days of supply analysis, the focus of the study turned to questions about the T-AKE's ability to keep up with the daily sustainment demand. This included questions related to all the scenarios envisioned for the operational environment; especially given the requirement to maintain a minimal logistics support structure (footprint) ashore to support the deployed joint force. Figure 7 depicts the T-AKE modeling framework.

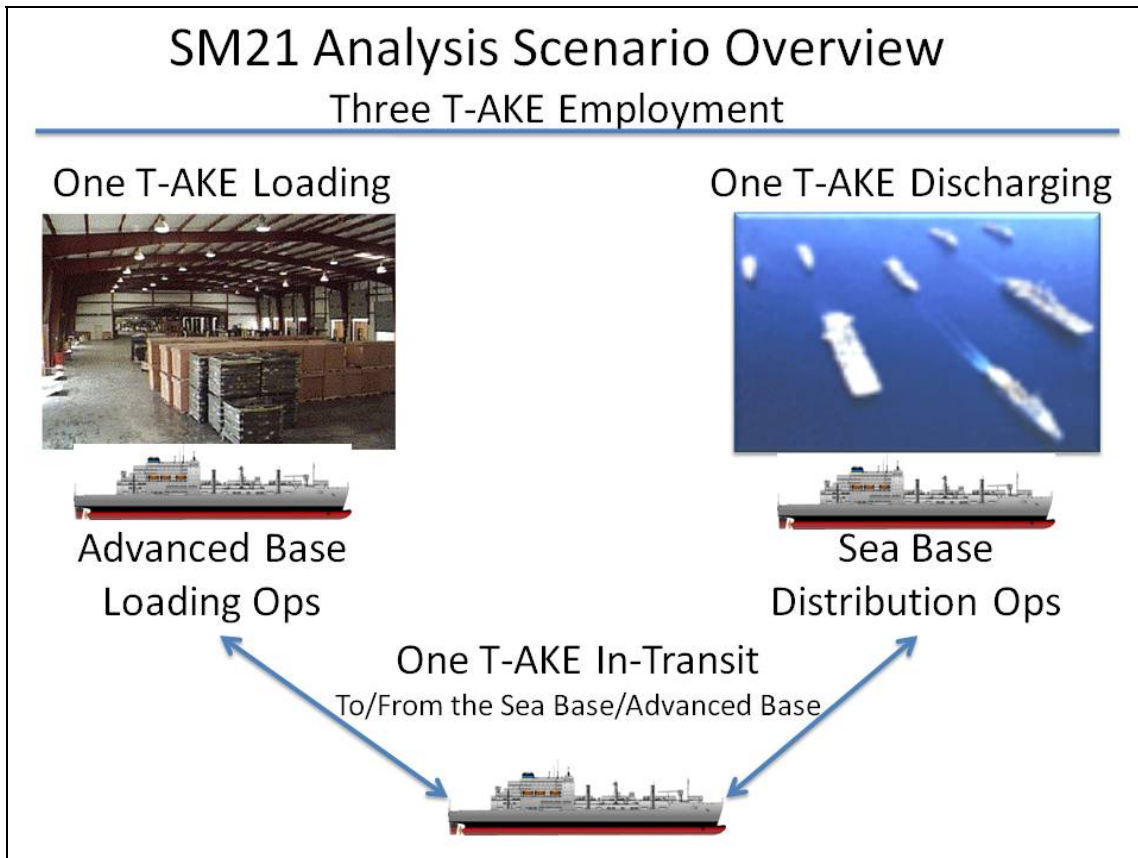


Figure 7: Modeling Scenario for T-AKE

3.3.2.3 Modeling, Simulation, and Analysis

Two Arena-based time domain models developed by SM21 can be adapted to the sea base environment. The models are the Multi-Modal Terminal Model (MMTM) and the Southern California Agile Supply Network (SCASN) model. The MMTM can be employed for advanced

base analysis and the SCASN model can be employed for modeling the flow of sustainment from the CONUS source to the advanced base. The SCASN model can also model and simulate the loading of the T-AKE after the JMIC stow and load plans have been established through the combined use of ICODES to stow plan ship and a ship loading optimization model. SM21 optimization models using CPLEX and MATLAB can be developed to support the sea base environment. To complete the initial SM21 advanced base and T-AKE employment analysis for this report, Excel based models were employed. At the same time, the requirements analysis for adapting the SCASN model to the sea based logistics environment was completed. The Excel models were used to support the analysis of sustainment distribution from an advanced based to the sea based employing three T-AKE. The demand based discharge of the sustainment stocks at the sea base from the T-AKE was also analyzed.

The model-based analysis, using SBLO developed operational planning factors and assumptions, determined that three T-AKE operating at distances up to 2,000 NM between the sea base and advanced base could meet only one operational scenario, Humanitarian Support, through the full intensity range. Figure 8 provides an overview of the associated Humanitarian Support analysis. The top graph in Figure 8 depicts the three T-AKE and their associated loaded JMIC inventory levels over time. Initially all three T-AKE were located at the sea base with 5,888 JMICs loaded on each in the proper sustainment mix to support the Humanitarian operation. The bottom graph depicts both the daily JMIC discharge requirement and the actual rate of JMIC discharge (UNREP). The Humanitarian requirement could be met during the entire 45-day period. Figure 8 indicates the daily discharge requirement and daily rate of discharge were compatible. The average UNREP time to meet the daily Humanitarian sustainment requirements was between 4 and 5 hours per day over the 45-day period.

Figure 9 provides the results of the low-intensity combat scenario analysis. Unlike the less demanding Humanitarian scenario, the modeling results indicated that three T-AKEs were not able to fully support the daily sustainment requirements for even the lowest intensity joint combat scenario. In other words, the T-AKEs could not operate as floating warehouses issuing sustainment on demand under as-is operating conditions during any form of joint combat operations.

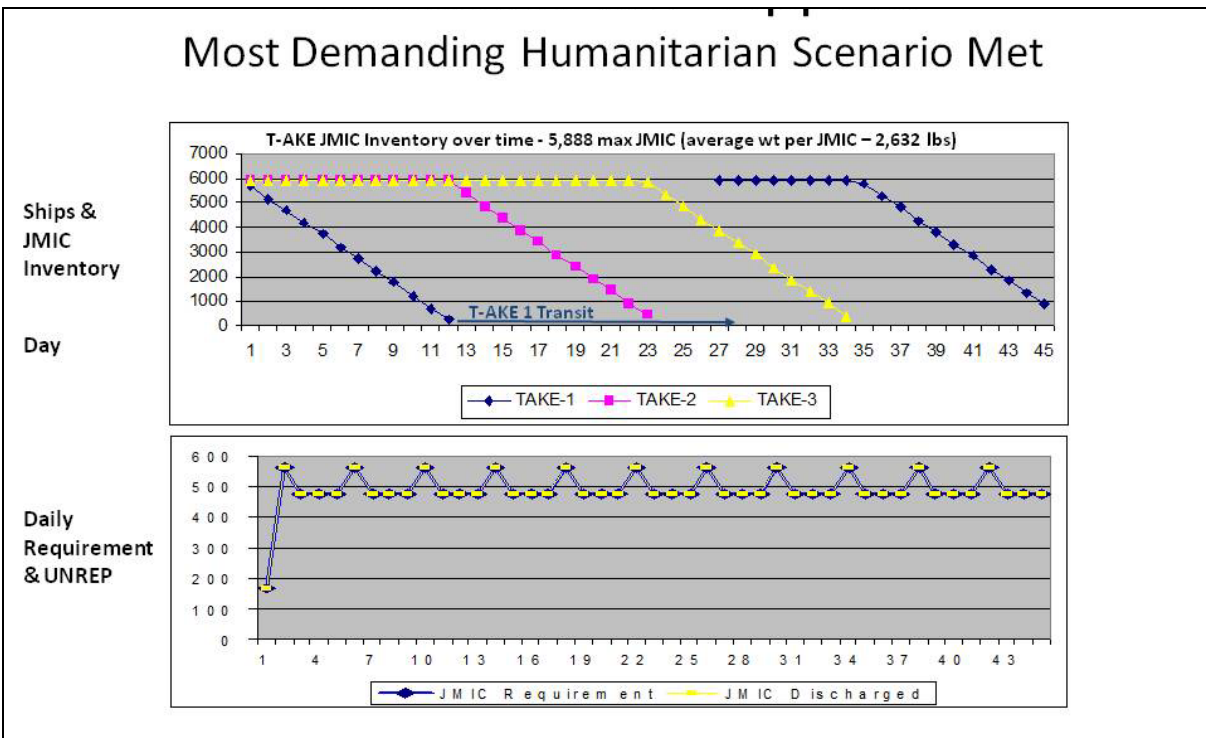


Figure 8: Humanitarian Support Analysis

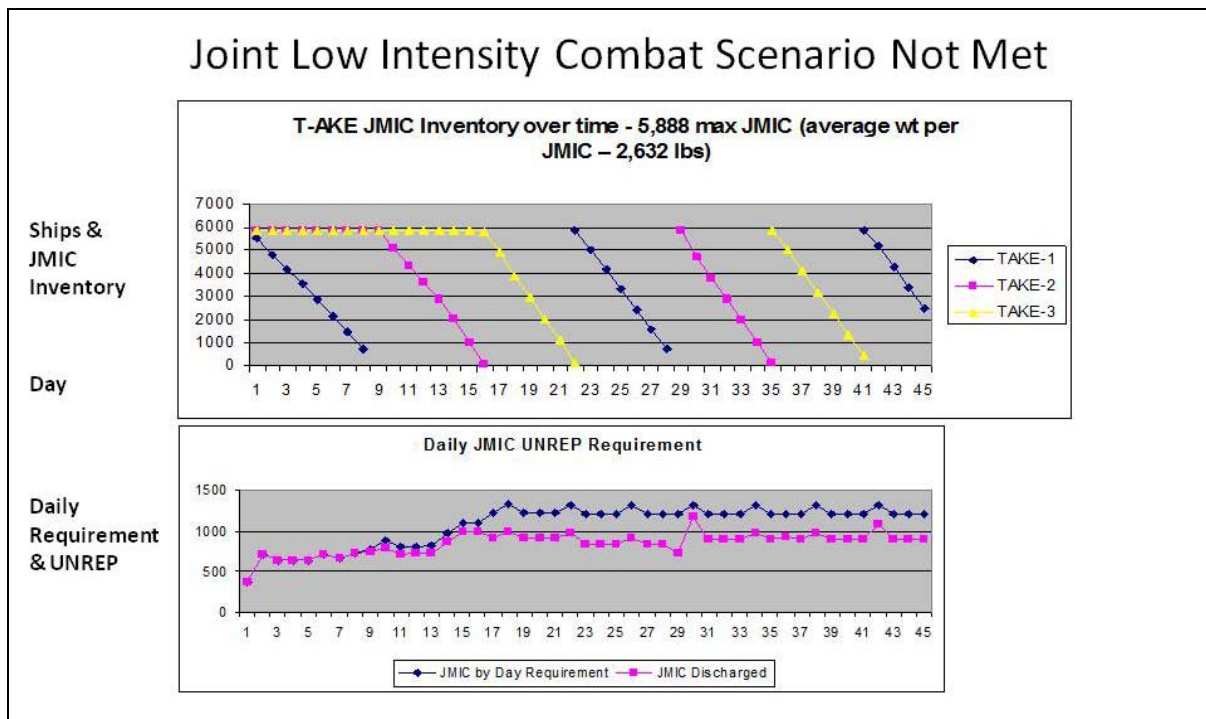


Figure 9: Low Intensity Joint Combat Support Analysis

The results of the SM21 analysis indicated that using the as-is operating processes, a fleet of three T-AKEs, with sustained speeds of 20 knots (17.5 knots speed of advance) supporting a sea

base 2,000 nm from the supporting advanced base, could not meet the full operational requirements of sustaining the sea base during low intensity combat operations. However, three T-AKEs could support the most demanding humanitarian operations.

3.3.3 Packing and Ship Load Modeling

Currently, the Services, direct vendors, and DOD distribution agencies all use a variety of different types and sizes of pallets, containers, and packaging. As a part of the SBLO analysis, an evaluation and comparison of two packaging systems was completed. The two systems analyzed were the Joint Modular Intermodal Distribution System (JMIDS) and the proposed 5QuadPod™ container system.

Both of these systems provide a standard modular container system that could be used in an intermodal environment with air, land, and sea transportation systems for both unit deployments and distribution of sustainment. In the case of the 5QuadPod, the container system is being designed to meet the distribution demands of both DOD and major commercial companies. Such a concept could reduce DOD's cost of development and maintenance. The 5QuadPod will be investigated further by SM21 during the proposed SM21 Experimentation Campaign.

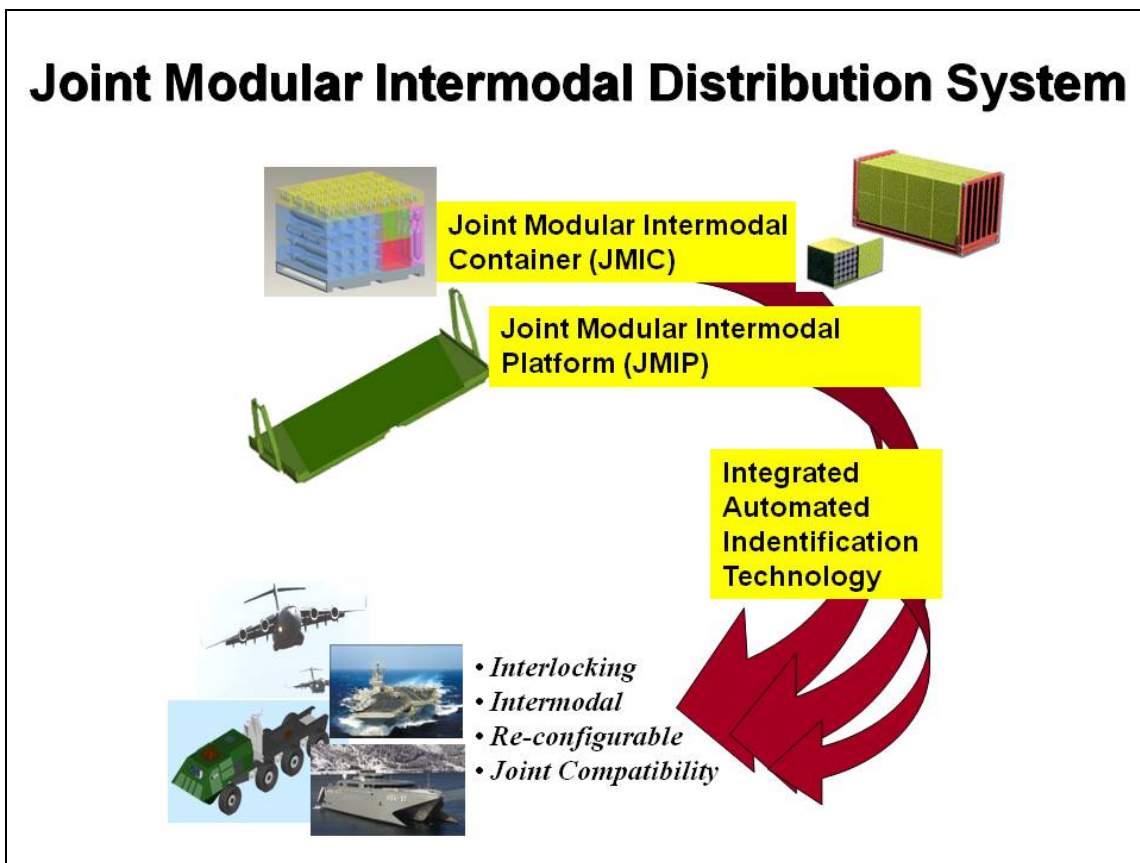


Figure 10: Joint Modular Intermodal Distribution System

The Joint Modular Intermodal Distribution System (JMIDS), as depicted in Figure 10, merges the JMIC and the Joint Modular Intermodal Platform (JMIP) development into a systems approach to provide an origin-to-destination cargo delivery system for all Services. The Navy-sponsored JMIC development effort was initiated in 2003, while the Army-sponsored JMIP was initiated in the late 1990s. The JMIP platform was designed to carry up to 16 JMICs and to interface with the existing Palletized Loading System and Heavy Expanded Mobile Tactical Truck–Load Handling System (HEMTT-LHS). Each JMIDS component will have an automated identification technology tag attached. Under JMIDS, the JMIP and JMIC are designed to work together as a single system or as separate independent systems.

JMIP is designed to provide interoperability among all modes of commercial and military transportation, including direct access to Air Force cargo aircraft. The JMIP all-mode capability is being designed with the intention to permit the movement of cargo from unit home station to destination without time and resource intensive handling and reconfiguration.

If used by all Services, the JMICs could increase throughput by streamlining the number and types of handling processes through the use of standardized cargo packaging modules. JMICs have the potential for several mission oriented variants, but their interface footprint would be standard. JMICs are also designed to be quickly loaded and locked to a JMIP, and to complement the Services' future automated loading systems and automated handling and storage systems along with emerging capabilities, such as Seabasing.¹⁴

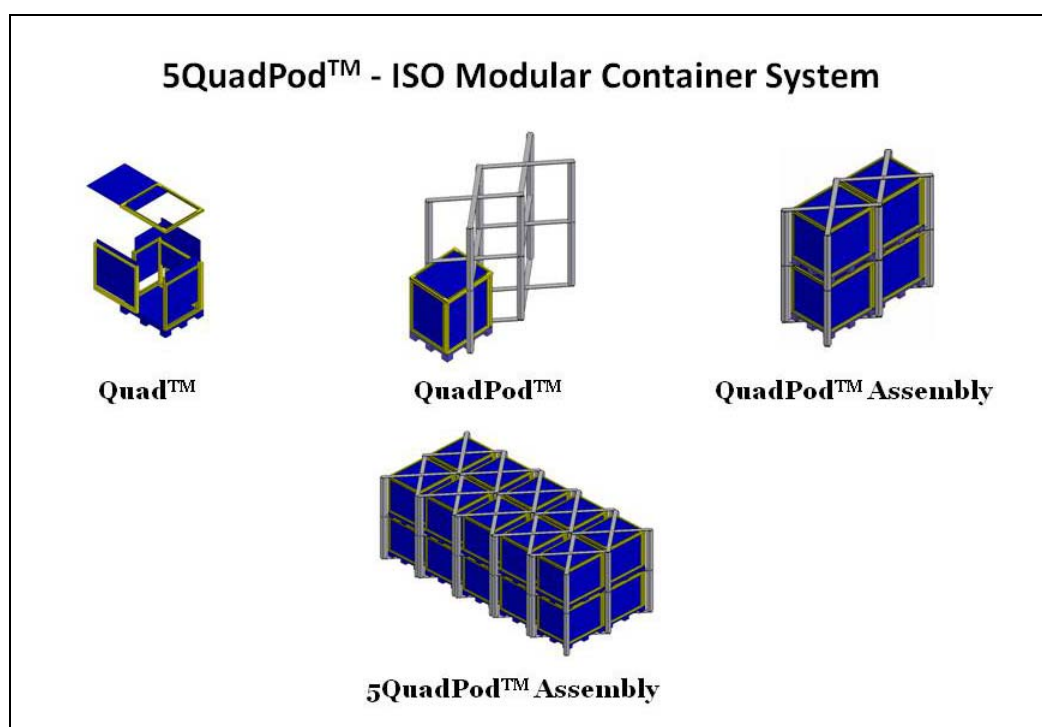


Figure 11: 5QuadPod™ ISO Modular Container System

The 5QuadPod system, Figure 11, is intended to provide a commercially viable and military useful system that is more flexible than the traditional Twenty-foot Equivalent Unit (TEU)

standard International Organization of Standards (ISO) shipping container. It is being developed as a “system of systems” employing an exoskeleton of frames (QuadPod) and smart secure pallets (Quads) to create a versatile, lightweight, and collapsible 20-foot ISO-equivalent shipping platform. The QuadPods are versatile frames that are being designed to provide transport via 20-foot (5), 40-foot (10), or 53-foot (13) trailer or flatbed configurations, common to truck and rail, or accommodate unitized load-out on C-17, C-130, and C5 aircraft. Two QuadPods can be configured to handle a 22,000 pound rotary-lift from the deck of a ship without additional packaging or physical handling.

A 5QuadPod consists of five articulated collapsible frames and 20 lightweight modular packaging units called Quads. Each QuadPod frame holds four Quads. The Quad is a modular packaging system consisting of a configurable pallet base and a box-frame with sliding panels. A Quad measures 40” by 48” by 45” and weighs less than 180 pounds. The QuadPod frame weighs approximately 500 pounds. The total designed tare weight for a 5QuadPod, including the 20 Quads, is 6,100 pounds. Each Quad can pack a minimum 2,500-pound load and the Quad-Pod frame can carry a minimum of 10,000 pounds. Minimum pay-load capacity for an articulated 5QuadPod is 25 net ST or a gross weight of 56,100 pounds. A Quad is being designed to carry up to 4,000 pounds, but pallets, if fully loaded, would exceed legal axle weight limits set by most states for 20-foot trailers.

Each articulated 5QuadPod frame is being designed to provide the sole load bearing element of the shipping platform. The 5QuadPod frame redistributes the stack-weight of the shipping platform over 30 integral pressure points to meet the equivalent four- point ISO 1496 standard established by the original ISO shipping container configuration. The structural elements of the exoskeleton use leading-edge composite and plastic-metal hybrid technology to reduce weight, while improving weight bearing capacity.

Figure 12 provides a pictorial of the JMIC cargo load areas on the T-AKE using the as-built, MARAD ship cargo arrangement drawings. The updated drawings were loaded into the ICODES–JNNI Module, which was then used to stow plan both the JMICs and Quads as depicted in Figure 12. Both systems were stow planned for comparative purposes to determine if either system offered any load efficiencies. The total number of JMICs stowed was 5,888 and the total number of Quads stowed was 5,920. While the numbers are comparable, Figure 13 compares the threshold payload weight of both the 5QuadPod and JMIC systems when shipped in an intermodal ISO TEU shipment configuration. This configuration would be the preferred method of shipping sustainment from the CONUS base to the advanced base for direct loading onto the T-AKE without the need for repackaging the individual JMIC or Quad. As noted in the Figure 13, the tare weight associated with the intermodal and interoperability requirements reduces the payload capacity of each JMIC. As previously noted, the JMIP and JMIC are designed to work together as a single system, as well as separate independent systems. However, they are integrated when shipped in the intermodal distribution system.

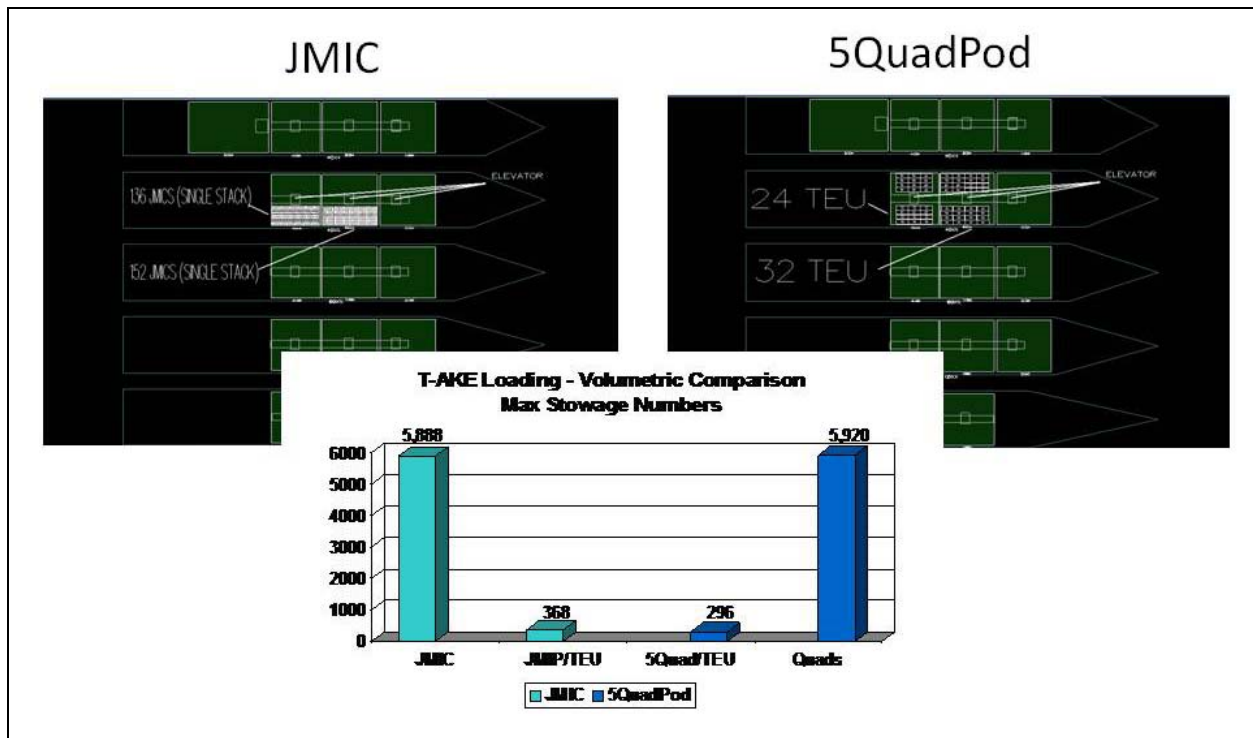


Figure 12: T-AKE Load Patterns for JMIP and 5QuadPod Packaging

JMIP has an 11 ST threshold payload. This threshold payload is required because all current HEMTT-LHS carry a flat-rack with 11 tons of cargo. The JMIP is inserted into an ISO commercial 20' 8" by 8' by 8' (minimum) end opening container when loaded with a single stack of eight JMIPs. However, double stacked JMIPs require a 9-foot ISO container (20' 8" long by 9' high).

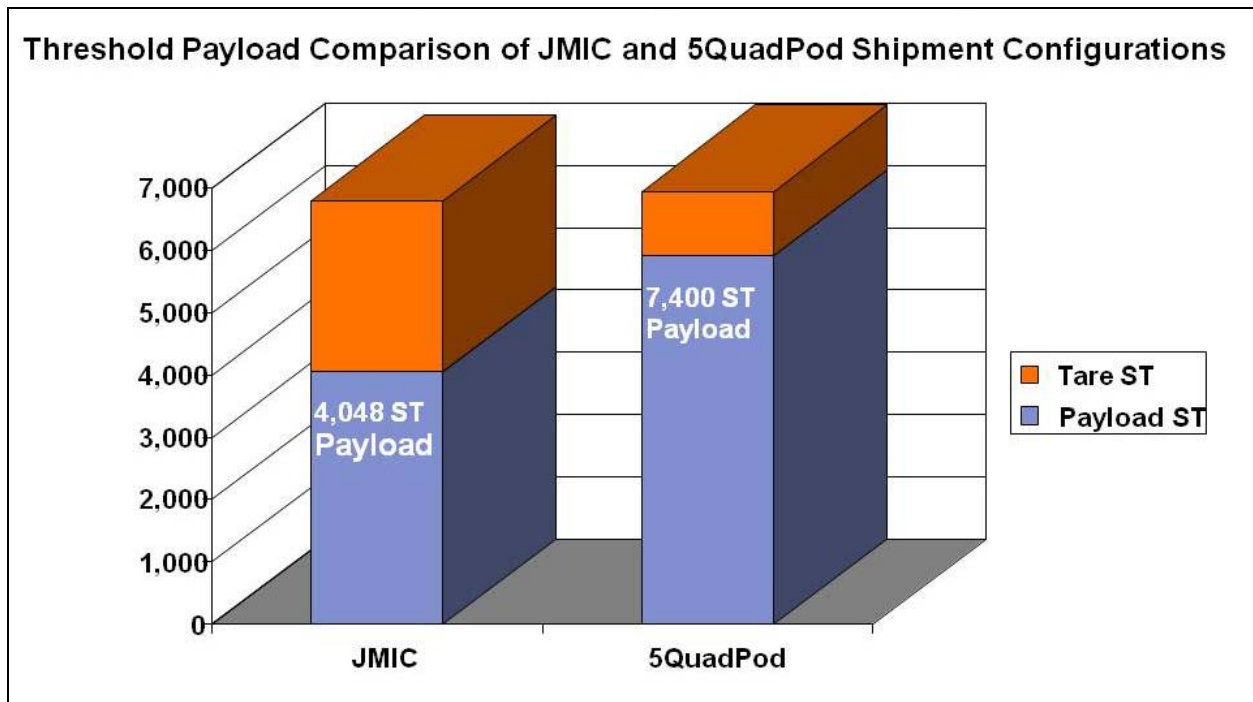


Figure 13: JMIC - 5QuadPod ISO Container System Tare and Payload Comparison

The analysis determined that the use of the 5QuadPod container system has the following potential benefits:

- Because of lower intermodal configuration tare weight as compared to JMICs, the Quads can effectively increase the capacity of the T-AKE by 3,352 ST.
- Since the 5QuadPod system is being designed for use by both commercial and military shippers, DOD system acquisition and maintenance costs could be reduced.

3.3.4 Advanced Base Analysis

The advanced base analysis focused on potential commercial support and the type of business processes that would be required to enable the T-AKE shuttle mission. The analysis began with a review of all existing Joint Capabilities Integration and Development System (JCIDS) documentation and previous T-AKE design and sea-based logistics capability analyses. Additionally, a review was completed of the most likely future advanced bases using both commercial and military infrastructure studies and analyses. After considering a range of hypothetical advanced bases, Guam was selected for analytical purposes. This analysis could be used in the future to establish an advanced base logistics architecture template for application at a future advanced base. Such a template could also be used for evaluating, selecting, and establishing an advanced base location for initial experimentation and joint force training.

The macro-level analysis objectives of this current study are listed below:

- Develop a modeling process to examine the advanced base logistics architecture required to support the T-AKE shuttle mission.
- Determine the operating profile for the T-AKE shuttle ships in support of sea-based logistics.

- Determine the most appropriate integration of commercial capabilities to support advanced base operations associated with the T-AKE shuttle mission.

Shipments of sustainment supplies from CONUS to the advance base, with the exception of ammunition and explosives (Class V), should be made by available commercial liner services. The policy of USTRANSCOM is to use commercial services first before considering government controlled assets. In our hypothetical advanced base, shipments would be made by commercial Jones Act Carriers. Currently, two carriers provide weekly commercial service to Guam. Horizon Lines provides an estimated weekly 1,020 Forty-foot Equivalent Unit (FEU) service and Matson can provide an estimated 1,431 FEUs per week. It is estimated that only about 25 percent of the available westbound capacity from CONUS is used for Guam cargo.²⁸ The remaining capacity is allocated to Hawaii or the Far East, or remains unused. This situation could change over time, but at present excess capacity is available to accommodate a surge in military shipping for the sea base.

The sailing distance between our hypothetical advanced base and West Coast ports is approximately 6,000 nm. As noted in Figure 14, the current service (transit) time from Oakland and Los Angeles is 13 days. The volume of CONUS–Guam trade is about 500 to 600 FEUs per week, with the total FEU capacity available being approximately 2,451 FEUs per week.²⁹ As previously noted, the requirements of the sea base could currently be met without adding additional liner capacity.

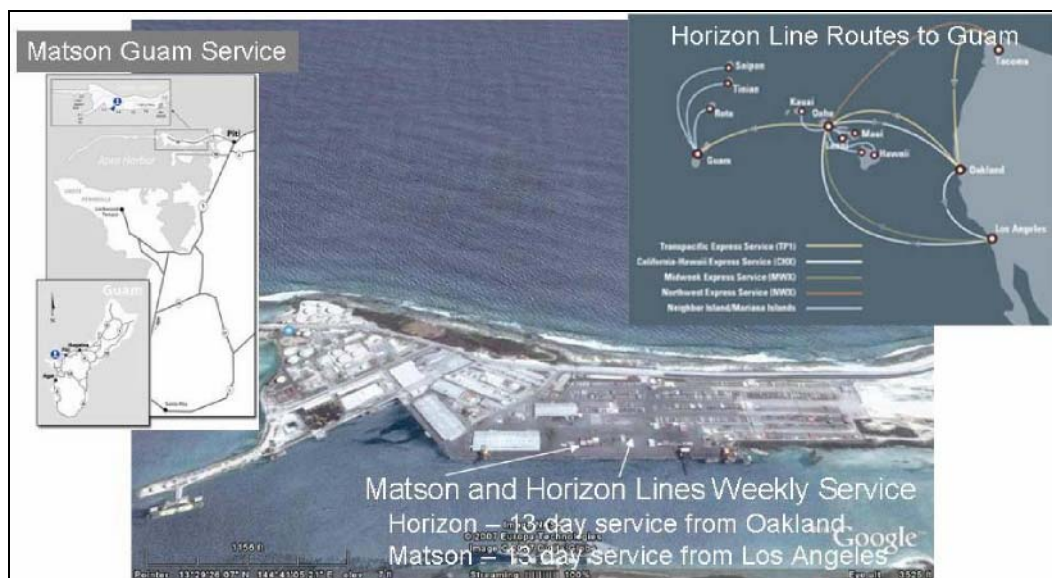


Figure 14: Commercial Liner Service to Guam

The processing factors for movement through the advanced base for this analysis are outlined below:

- Since JMIC containers can only be single stacked in a standard 20 foot container and if standard height containers were used, the number of containers that would require

²⁸ Maritime Administration, Competition in the Noncontiguous Domestic Maritime Trades, May 2, p. 37.

²⁹ Ibid., p. 38.

processing per week would be 1,960. However, if 20 foot containers 9'6" in height were employed, the JMIC containers could be double stacked reducing the total number of containers requiring processing to 980 per week.

- An average of 19 percent of 20-foot containers would be Class V shipments on government controlled charter and off-loaded at the designation ammunition pier or anchorage.
- Transit time from the West Coast averaged 13 days.
- Ship unloading, terminal and gate processing, and transfer to T-AKE loading point required 2 days.
- T-AKE loading would require 2 days (this is study established objective-the current loading time is estimated at eight days).
- Transit back to the advanced base would be 5 days given 2,000 nm separation and a 20-knot sustained speed (17.5 speed of advance).

Analysis of the infrastructure, available commercial services, and advanced base support requirements were used to determine the optimal processing times for containerized shipments from the West Coast to the sea base.

It should be noted that additional time for CONUS Material Release Order (MRO)³⁰ processing, source selection, and cargo consolidation would need to be added to the measurement of the E2E customer wait time. Additionally, the shipment transit time to the West Coast terminal or Military Ocean Terminal, Sunny Point, NC (Class V handling facility), and export terminal processing time would be required. The CONUS order processing and distribution analysis is currently being completed by the SM21 program and will be supported by the enhanced SCASN model. Completed research indicates that the total container shipment and processing times from a West Coast terminal to the sea base would range from 22 to 31 days, with an estimated mean time of 26 days.³¹

Up to 36 percent of the DOS requirement would be Class V ammunition depending on the OPTEMPO. This amount of Class V would require shipment through separate military-controlled ocean terminals in CONUS and any advanced base to avoid violating net explosive weight restrictions. Class V shipment consolidation, shipment under military-controlled container ships, and advanced base offload at an explosive anchorage buoy would create more complexity in pre-configuring loads for rapid 2-day T-AKE loading.

Currently, several factors are causing delays in receiving and berthing commercial liners in Guam. It should be assumed that all advanced base facilities would require some modification to improve overall port throughput capacity, reducing vessel processing and container terminal dwell times. The application of Agile Port System commercial infrastructure supported by the SM21 enabling operating system technology will be considered in future SM21 supported studies.

³⁰ MROs are issued by an inventory control point or accountable depot or stock point directing an storage site or materiel drop point within the same supply distribution complex to release and ship materiel.

³¹ The SM21 program is conducting research to analyze and validate sea-based logistics CWT associated MRO processing and CONUS distribution.

Since most potential advanced base operations, all container movement on and off the terminal would need to employ over-the-road drayage operations. Since our hypothetical advanced base does not have rail service, commercial tractor trailers would be required but they are limited and the same condition should be expected at most potential advanced base locations. This situation would require the movement of deploying unit equipment by military convoy and containerized sustainment shipment clearance from the port by military and/or commercial drayage operations.

In order to supplement the available commercial flatbed trailers and heavy equipment transports, a U.S. Army Medium Truck Company would need to be brought in to the advanced base early in the deployment cycle to facilitate advanced base port clearance. Alternatively, for the containerized sustainment shipments for the sea base and deployed joint forces, consideration should be given to contingency contracting with commercial liner services for the provision of full intermodal service to the T-AKE load staging point on the advanced base.

Optimized load planning for T-AKEs would require a designed staging area for load sequencing preparation such as is planned at the potential advanced base that we used in this study. The route from the commercial container terminal to a proposed staging area randomly selected was mapped for analysis using the Google Earth mapping and distance calculation service (see Figure 15). This type of mapping and route distance calculation service could be built into an advanced based collaborative planning and execution tool for use by logistics planners at all levels and locations.

Unloading the containers at the commercial terminal, terminal and gate processing, and transit to the T-AKE temporary storage and staging area would take approximately 2 days for the hypothetical advanced base under study. A review of other potential advanced base sites indicates that 2 days would be a reasonable average time for container processing and drayage operations. The location in this study is capable of processing approximately 1,171 containers daily (a combined military and commercial capability). The military load terminal located on the potential advanced base is assumed to have a container staging area of approximately 40,000 square feet. This staging area would be used to stage containerized ammunition prior to T-AKE loading.

Advanced base cargo and joint force deployment distribution operations would be managed by USTRANSCOM. At an advanced base conducting joint operations, a transportation battalion or detachment assigned to the Surface Deployment and Distribution Command (SDDC), a USTRANSCOM subordinate command, would manage transportation functions. The advanced base under analysis is supported by a detachment assigned to a SDDC Transportation Battalion. To assure the smooth flow of sustainment and forces through an advanced base, commercial stevedoring and drayage services should be contracted in advance of the sea-based logistics operations. To support commercial operations, each advanced base should be supplemented by designating a military Port Support Activity (PSA).

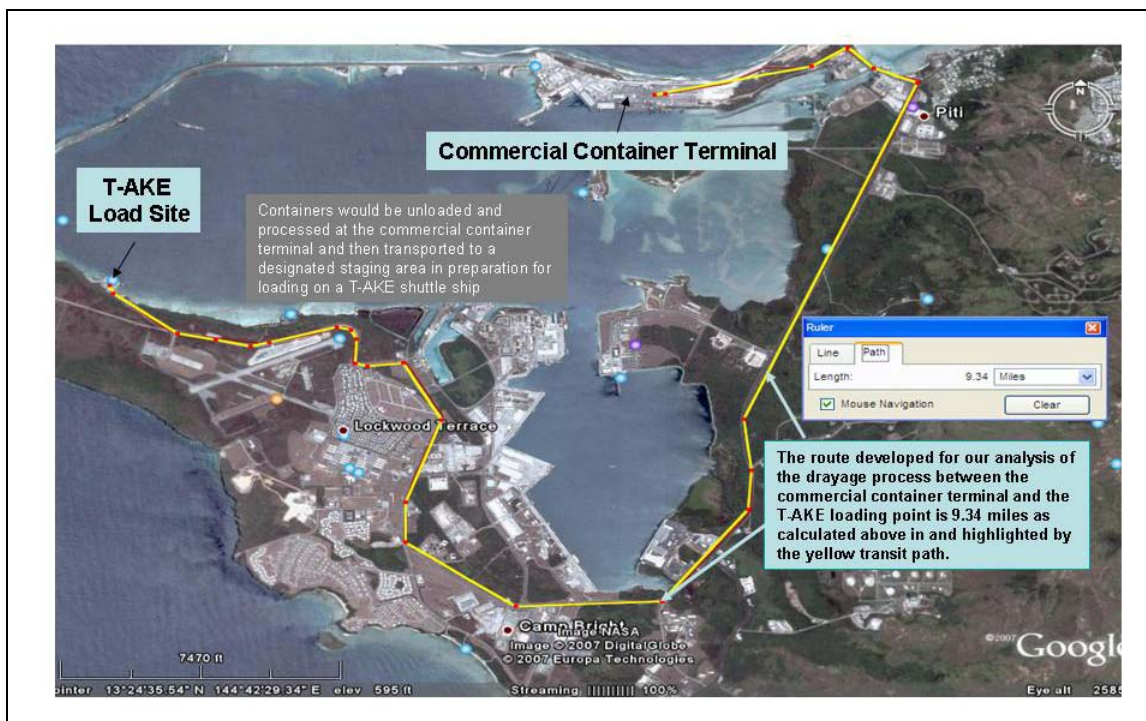


Figure 15: Example Advanced Base Container Drayage Route

In order for trans-load operations to be successful, the SM21 top-level modeling shows T-AKE load planning must begin at the time the MROs are issued. Source selection and shipment consolidation must consider the loading requirements of the T-AKE. Load planning must be focused on staging cargo to be loaded to enable rapid sequential loading. Load planning must consider the requirement to selectively offload sustainment at the sea base. Given the demanding daily sustainment requirements established during the SBLO analysis and the results of the T-AKE employment options modeling, the T-AKE is able to minimally meet the humanitarian scenarios with 2 days of loading at the advanced based assumed³². Without proper load planning and prior knowledge of the cargo loading sequence, the loading process often takes 8 or 9 days, which was considered standard operating practice for CLF T-AKE.

In order to meet the significant demands of selective discharge at the sea base, the T-AKE ship loading support system, ICODES, and the T-AKE load management system should be integrated within an overall Service Oriented Architecture that supports E2E T-AKE load planning and inventory management planning and dynamic re-planning. In addition, the packaging system used for sea-based logistics operations should support both selective offloading and the tracking of individual line items within the packaging. Without the ability to track and access specific line items, such as medical supplies and repair parts, there is the possibility of delays in processing sustainment orders and the potential for more inefficient capacity utilization of the T-AKE. Current T-AKE loading processes at the advanced base must be revised to enable a

³² The T-AKE MPF (F) Cargo Throughput Analysis, completed on January 18, 2006, indicated that the pierside crane rate for JMIC containers was 68.4 JMICs per hour per crane. This result indicates that a full load of JMICs could be completed in less than 48 hours.

significant reduction in the current CLF T-AKE load design standard of 8 days.³³ As previously noted, the total load time for a sea base T-AKE shuttle ship can be no longer than 2 days to meet the required DOS support for all humanitarian through major combat scenarios.

The initial SM21 analysis established the need for revised trans-load advanced-based processes to be examined in much greater detail than time would allow in this macro-level analysis. In support of such efforts, the SM21 program is currently working on the development of a dual-use, multi-modal terminal architecture that could be adapted as a template for establishing advanced-base operations. The development and use of a template will continue to be studied and developed during future modeling, simulation, and analysis.

The completed SM21-SBLO advanced-base analysis resulted in the development of a proposed revision to the MPF (F) operational profile for sea-based logistics support. The findings of our macro-level analysis are summarized below and in Figure 16:

- The port T-AKE operations require a reduction of 6 days from the 8-day CLF design standard to meet joint sustainment scenarios. The proposed revised standard is 2 days.
- Transit times of 10 days are appropriate for a transit cycle from/to the sea base given: a 2,000 nm separation; designed sustained speeds of 20 KT; and 17.5 KT speed of advance.
- T-AKE UNREP time at the sea base must be increased to 10 complete days from the CLF design of 8 days. The increase in on-station time should be achieved through the creation of more cargo stowage space by employing more efficient loading, sustainment packaging, and improved selective off-loading capability.
- Current manning and UNREP processes and associated times fully meet the MPF (F) only T-AKE requirements.

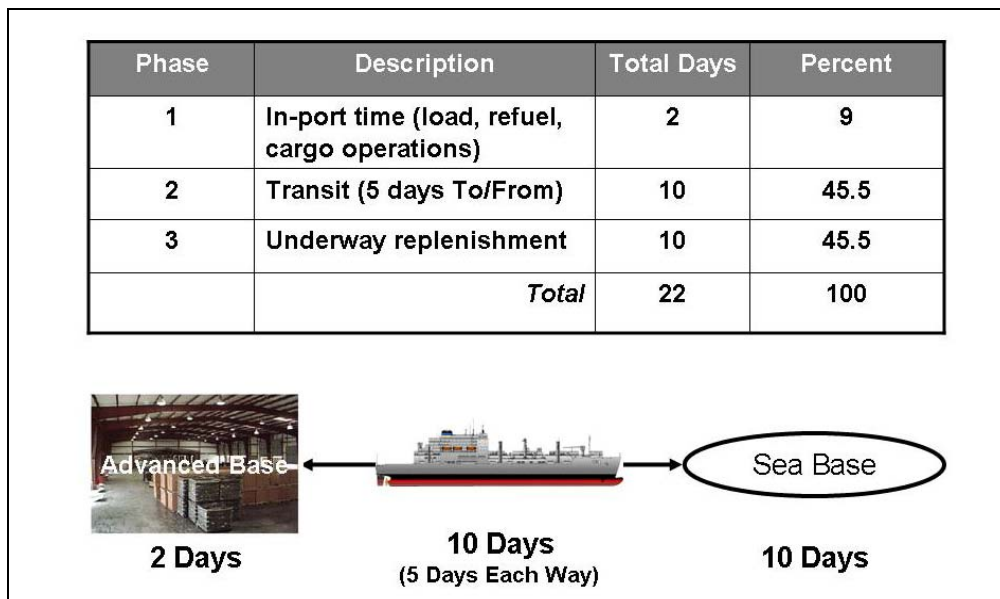


Figure 16: Proposed T-AKE Sea Based Logistics Employment Standards

³³ Naval Sea Systems Command SEA 05, *System Specification for the Dry Cargo/Ammunition Ship – T-AKE I Class*, September 26, 2003.

4.0 SM21 SEA BASED LOGISTICS EXPERIMENTATION CAMPAIGN PLAN

Sea based logistics offers SM21 the opportunity to demonstrate the scalability and adaptability of concepts developed for the JDDSP SOA. To this end, the JDDSP SOS architecture was designed to include support to the advanced base and sea based logistics.

The JDDSP SOS architecture is being designed to provide timely, actionable data to those responsible for the execution of the “on the ground” functions required to deploy forces and distribute sustainment. The provision of actionable information involves the processes associated with collecting timely and accurate data and transforming this information to knowledge to enable timely actions in the physical domain at the right place and time. To validate the JDDSP SOS architecture’s ability to provide action level workers in the sea based logistics environment the required information and knowledge to make appropriate, timely decisions, SM21 will conduct a number of experiments and demonstrations. The intent of the experiments will be to support the physical development of the JDDSP sea based logistics support concepts and the enabling architecture. The initial set of experiments is described below; however, Appendix B contains a more complete listing of experimentation opportunities that will be explored for future year experimentation.

During the SM21 FY06-07 program years, working with military and commercial stakeholders, the initial design and development of the Inland Port-Multi-modal Terminal Operating System (IP-MTOPS) will be established as a collection of services within the overall SM21 SOA. This initial IP-MTOPS design, which is being developed within a SOA to ensure a more secure and scalable system, focuses on: optimizing logistics flows; supporting JDDSP facility security requirements, maintaining required throughput productivity; and providing high service quality to strengthen customer relationships. IP-MTOPS will be supported by dynamic load planning services, integrated with ICODES³⁴ or other stow planning software, which will also be designed to support T-AKE loading operations at the advanced base.

In addition to SM21 developing IT services to track and manage shipments as they transit logistical nodes and are loaded unto transport modes, research is being conducted to develop effective shipment packaging configurations that seamlessly move through deployment and distribution nodes and transfer between transportation modes. SM21 has evaluated the utility of both the JMIC and the evolving 5QuadPod system overviewed in Figures 11 and 17. Both the JMIC and 5QuadPod systems provide more flexible packaging options that support the special needs of Seabasing for:

- Selective on-load/offload of shuttle ships (T-AKE)
- Strike up/Strike down operations, particularly in high sea states
- At sea cargo transfers (Skin to Skin transfer)
- Capabilities of current and future combat operations to handle delivered goods

³⁴ SM21 CLIN 0011, ICODES Extension Technical Plan

The initial SM21 experimentation campaign plan was designed to support the development of the overall JDDSP SOS architecture and the IP-MTOPS services. The experimentation will be supported by extension of the SCASN model to include support for the evaluation of the required SM21 Sea Based Logistics Architecture. The five year experimentation plan will culminate with a demonstration of the packaging and JDDSP SOS capabilities during a Joint Combatant Command Seabasing exercise. Figure 2 provides a high level overview of the transportation and sustainment pipeline that the JDDSP would support during a Joint exercise. As depicted, the pipeline would originate at the CONUS source, be supported by the JDDSP prototype site in Victorville, CA, and would end with the loading of supplies on a T-AKE at the advanced base.

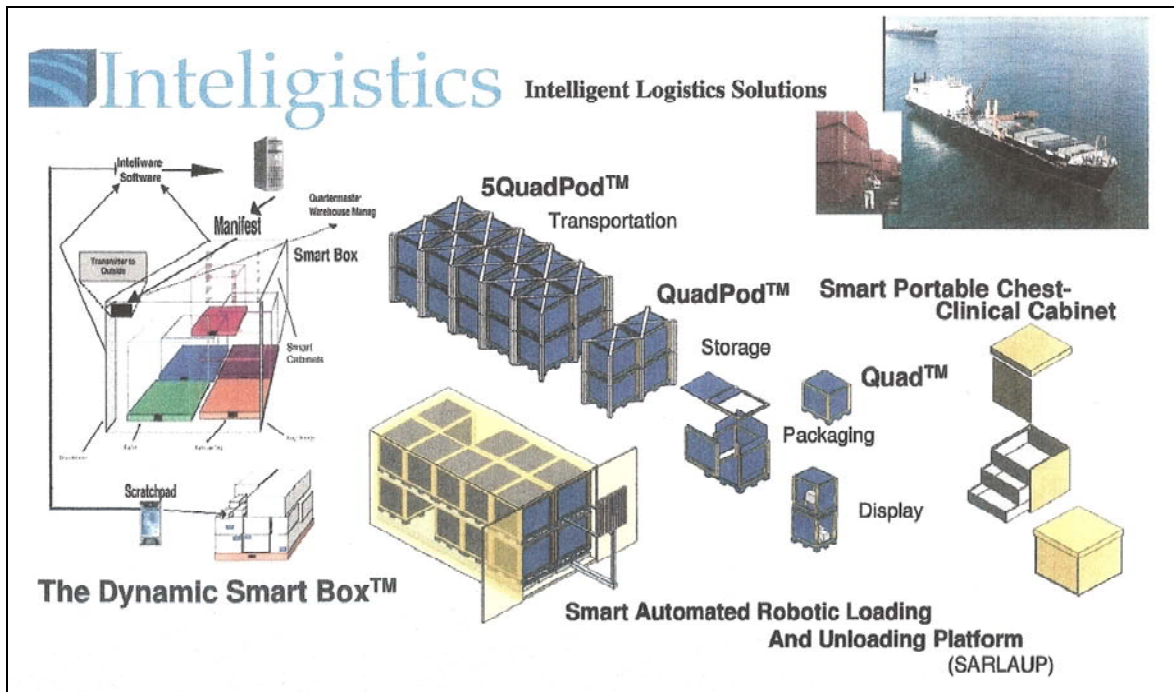


Figure 17: 5QuadPod Concept

4.1 Sea Based Logistics Experimentation Hypothesis

If a new modular packaging system supported by dynamic stow and load planning services, can be built, then three logistic support ships (T-AKE) will be able to sustain two deployed joint brigades through a sea base located up to 2,000 nautical miles from the advanced base³⁵.

4.1.1 Initial Problem to be Studied/Goals and Objectives

The 5QuadPod™ is designed as a collaborative project with the TATRC (Telemedicine and Advanced Technologies Research Center) a subordinate command of the US Army Medical Research & Materiel Command. The intent is to explore the use of the 5QuadPod™ for the distribution of Class VIII, medical supplies, with a focus on sea based logistics. The initial

³⁵ The T-AKE support ships will shuttle supplies from the advanced base to the sea base. The T-AKE would remain on station at the sea base until their supplies reached a safety level at which time they would return to the advanced base for reloading. The T-AKE would act as a floating warehouse discharging the correct mix of supplies by Class on a just in time pull basis versus employing a push basis.

problem to be studied is: will the 5QuadPod™ meet the ISO Standard 1496; used to certify shipping containers? The development of a digital, computer based model of the 5QuadPod™ will be essential to validate the design process; to aid with the selection of materials, including the use of new composites; and to incorporate predictive Finite Element Analysis to show how the 5QuadPod™ will react to various stress and load conditions associated with the ISO Standard. A computer model will also provide a useful tool to demonstrate the versatility of the 5QuadPod™ and help prospective users to visualize viable business case scenarios.

The initial year 5QuadPod™ design objectives, which are intended to improve the viability of sea based logistics, are to:

- Reduce the current tare weight of the ISO container to increase the payload capacity of the container and overall T-AKE
- Increase the T-AKE loading rate through simultaneous loading of multiple pallets
- Accept a standard pallet dimension of 48"x40"x45", permitting better allocation of space and distribution of cargo on T-AKE
- Reduce the empty footprint of the container to permit knock-down to nest five 5QuadPod™ units into one to reduce empty handling time and space on the T-AKE
- Allow complete economical repair and recycling of worn frames and pallets
- Independent of the shipping platform, permit each pallet to function as a flat-pallet, bin, secure box or open box-frame
- Make use of compatible materials friendly to RFID/sensor technology and transparent for X-ray and scanning technologies currently in use by the U.S. Customs and Border Patrol and
- Eliminate time-consuming banding, blocking and bracing; and a myriad of other platforms currently used to prepare small shipments, which would reduce current T-AKE loading times

4.2 Way Ahead to the SM21 Capstone Experiment

Since a sea based logistics demonstration will be the SM21 JDDSP experimentation campaign plan capstone event, as depicted in Figure 1, the sea based logistics campaign plan will be more fully developed at the end of the first year of the experimentation campaign plan in a separate technical report. Since the sea based logistics capstone demonstration will be built upon prior dual-use experimentation, the project management plan will document how each SM21 experiment supports the capstone demonstration. SM21 will collaborate with US Joint Forces Command to establish a sea based logistics experimentation and joint training campaign plan.

The sustainment of two deployed joint combat brigades through the sea based logistics architecture will require all of the capabilities nominated for experimentation by SM21. This includes a dynamic ship load planning service, advanced packaging systems such as the 5QuadPod™, modal diversion capabilities, and supply chain distribution practices that respond to each Class of Supply independently based on the functional or innovative nature of the products. As depicted in Figure 18, sensing sustainment requirements as early as possible and dynamically managing the distribution pipeline will reduce overall cost and achieved a significantly higher demand satisfaction rate.

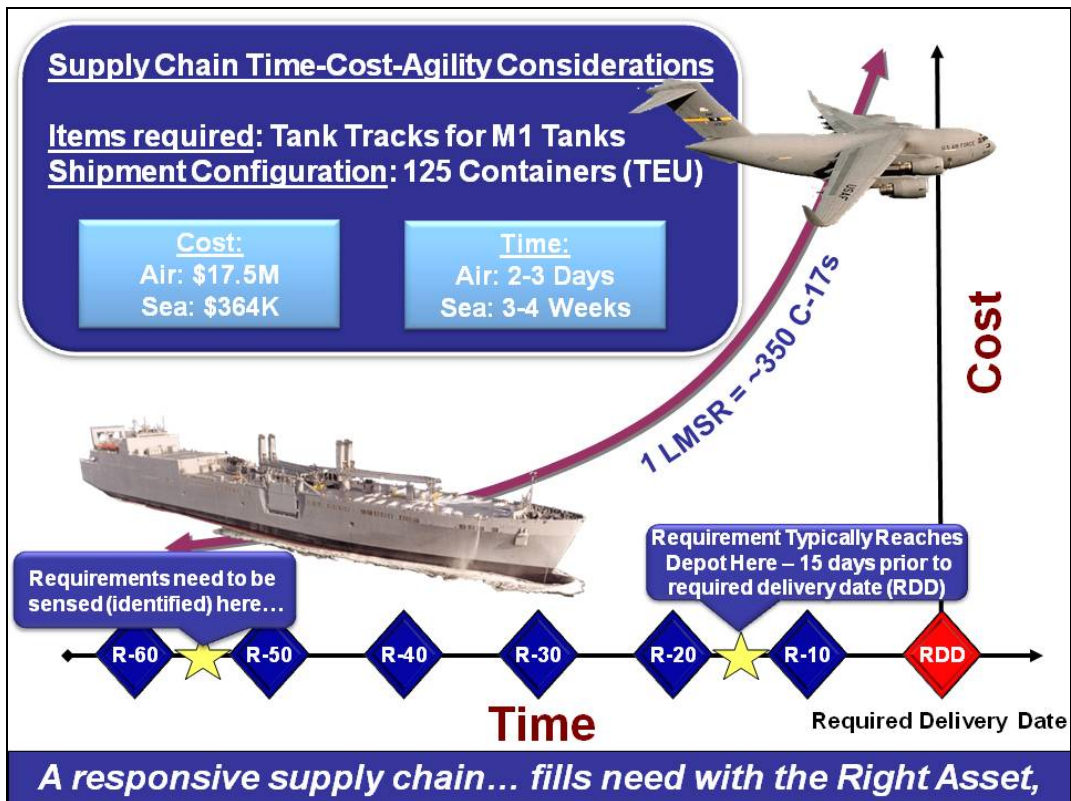


Figure 18: Supply Chain Responsiveness Considerations³⁶

During the commercial supply chain experimentation processes, the impact of functional and innovative products on the supply chain “deliver” functions will be studied. Lessons learned will be applied to military supply chains. The most challenging military supply chain from a “deliver” perspective will be the support of deployed joint forces through a sea base. This is the rationale for SM21 picking the sea base as the capstone JDDSP demonstration. A definition of supply chain product characterization adapted by SM21 follows³⁷:

- **Functional Products:** Include commercial staples that people buy in a wide range of retail outlets, such as grocery stores. For the military this would equate to Class I subsistent including the range of food starting at meals ready to eat (MRE), through semi-perishable, to perishable fresh food. Because such products satisfy basic needs, which don’t change much over time, they have stable, predictable demand and long life cycles. Functional products require cost effective but reliable, quality delivery partners within the supply chain.
- **Market Responsive Products:** Innovative, market responsive products in the commercial sector include products that many companies introduce to avoid low profit margins. Fashion and technology innovations are added to give customers an additional

³⁶ Selected data taken from the USTRANSCOM Joint Exercise Program Overview developed by COL Stan Wolosz

³⁷ Harvard Business Review on Managing the Value Chain, “What is the Right Supply Chain for your Product?”; Marshall Fisher, pp. 127-154

reason to but their offerings – everyone needs the latest and greatest clothing line or computer. These products have volatile demand and require a fundamentally different supply chain than stable, low-profit margin functional products. For the military, an example of a market responsive product would be Class VIII medical supplies. The need for medical supplies is very unpredictable prior to the commencement of fighting and the introduction of forces to a foreign environment. After engagement and over the life of the deployment conditions change and the demand for different medical supplies changes. Innovative and market responsive products require that delivery partners be selected primarily for speed, responsiveness, flexibility, and quality. The cost of distribution is a much lower metric to be considered.

The misalignment of supply and product strategies can result in waste and great dissatisfaction among customers in both the commercial and military sectors. Aligning the product to the proper distribution processes, assets, and network is not an easy function but this careful, dynamic alignment is an absolute requirement for Sea Based Logistics.

APPENDIX A – Experimentation Opportunities: Gaps – Solutions - Capabilities

Appendix B introduces some additional existing gaps, solutions and capabilities identified in looking at the relationship between Sea-Based Logistics and the JDDSP as systems within the deployment and distribution process. In addressing these issues, there are concepts and operations being developed for the JDDSP that can help close some of the existing gaps and may be areas for future experimentation.

1.0 Pre-positioned ASL vs. Demand -- Stock Location Optimization

An issue identified by a Rand Study in the assessment of logistical support for Operation Iraqi Freedom, was the mismatch between the Authorized Stockage Loads (ASL) provided in propositioned sets, and actual demand for parts during combat and stability operations. The conclusion was that there is a need for new and better ways to identify parts demand, and thus be better able to assure critical parts were available when needed.³⁸

This is especially critical because space and mobility constraints for units engaged in combat dictate that only the minimum essential items are moved with the units. While the facilities of a Sea-Base will be significantly larger than those available to most combat formations, the Sea-Base will be inherently constrained in storage space, and will need to make maximum effective use of all storage space available.

The JDDSP SOA located in CONUS and at the advanced base can provide port C² facilities capable of identifying optimal storage (buffer) locations for ASL parts, within the deployment and distribution system of systems, that can involve tradeoffs between criticality of specific parts, transport distances, transport costs, stockage costs, scarcity of asset, etc. to determine for a given set of circumstances, where is the optimal storage location. In short the JDDSP offers a location to provide Vendor Managed Inventory services to the warfighter, as well as those services to constrained deployment and distribution nodes like a Sea-Base.

2.0 Cargo Trans-shipments

Another issue involves cargo trans-shipments. One concern coming out of Iraq is the continued disconnect between strategic and tactical distribution, which is perpetuated by the differences of effectiveness and efficiency at the strategic and tactical levels. It is efficient and effective to package things in standardized Twenty Foot Equivalent Unit (TEU) containers. That makes handling in port very efficient, and is a very effective way of utilizing transport capacity.

Sea-Basing with current technology is not adequate to interface transoceanic commercial air or sealift modes. Deliveries to Sea-Bases will need to be routed through an intermediate staging base or advanced base capable of receiving strategic airlift and sealift modes, with transfer to

³⁸ Sustainment of Army Forces in Operation Iraqi Freedom, Eric Peltz, Marc L. Robbins, Kenneth J. Girardini, Rick Eden, John M. Halliday, Jeffrey Angers, Rand Corporation 2005

operational mode carriers, such as the TAK-E that can more easily interface with Sea-Base cargo transfer systems.

The Defense Science Board, in their analysis of Sea Basing identified “The capability to handle cargo in rough seas characteristic of many likely areas of operations”³⁹ as a critical capability necessary to enable Sea Base operations. Thus the methods of packaging materials to be transloaded through the Sea-Base will be critical to enabling Sea-Base operations. A related issue, particularly with the need to transload Sea-Base bound shipments at either an ISB or advance base in the vicinity of the Sea-Base, is the need to develop methods to make containers truly intermodal within both the commercial and military distribution domains to minimize handling requirements as materials flow from strategic lift assets, to operational lift or tactical lift assets.

3.0 Intermodal Transitions – Strategic Loads to Operational/Tactical Loads

Intermodal transitions will be an issue for Sea-Based distribution hubs. How do they handle the transition from TEUs to tactical loads for transport by rotary wing aircraft or by watercraft utilizing immature or inadequate port facilities? SM21 has analyzed this issue and has planned experimentation with modular packaging that can be configured into TEU shaped loads, and easily broken apart into smaller more manageable sized modules for tactical delivery.

Load Size: Containers in the TEU/FEU configuration provide efficient strategic load characteristics, while tactical units on the other hand, have smaller vehicles to transport supplies, and often do not need amounts that are shipped in such containers. Using a Stryker Brigade as an example, an examination of the issues surrounding the appropriate size containers for packaging unit sets of configured loads for sustainment can be explored. Using OPLOG Planner, it is estimated that a Stryker Brigade would need roughly 20 tons of supplies daily or about ten Heavy Expanded Mobility Tactical Trucks - Load Handling Systems (HEMTT LHS) loads. That breaks down to slightly over one CL V HEMTT load, and about eight HEMTT loads of mixed CL I, CL II, CL III (P), CL IV, CL VII, and CL IX (the items the BSB supply section is designed to process). While it may be effective to deliver 20 foot sized container loads to the Brigade Support Battalion (BSB), the BSB supports 5 battalions (3 Infantry Battalions, 1 Artillery Battalion, and 1 RSTA), the BSB itself, and an additional battalion equivalent (in size) composed of the independent companies within the Brigade.

³⁹ DSB Task Force on Seabasing, August 2004 pg x



Figure B-119: Heavy Expanded Mobility Tactical Trucks - Load Handling Systems

Average daily Battalion sized packages would fit into one HEMTT LHS load, averaging .9 HEMTT load per battalion. With the exception of the Artillery Battalion, CL V loads to individual Battalions are not significant in size. Daily requirements vary from 1.6 containers for the BSB (up to 2.2 if you include the separate companies being supported by supply point distribution from the BSB) down to approximately .6 containers for the RSTA. The Infantry Battalions need .8 containers daily, and the FA Battalion, less CL V, would need about .4 containers of sustainment materials daily.

At this point, TEUs are still an effective means of delivery; however, delivery to individual company sized units begins to become problematic. First, company units have Family of Medium Tactical Vehicles (FMTV) and other mission oriented vehicles, and do not have the HEMTTs necessary to transport LHS containers. Thus for delivery to company elements, containers must be broken down either in the BSB prior to beginning CSS operations to brigade elements, or within the LRP as companies draw their resupply. There is limited MHE at the BSB to accomplish this mission, and less once moving forward to resupply company elements.

Company level average about .13 containers per day, with the high being Rifle Companies, BSB HDC and the FMC requiring slightly over .2 containers per day, and the low were several companies requiring .07 -- .08 containers per day. Thus, at company level, a container that could handle roughly 2500 – 3000 pounds would be about right for delivering daily supply requirements and would be much easier to handle than 20 foot containers delivered by HEMTT.

Delivering TEU sized packages in a Seabasing contingency presents numerous problems. First, it will be difficult for T-AKEs to receive TEUs for storage that provides the access requirements for selective off loads. Technology for transferring TEU sized containers at sea is limited today. Even without those challenges and constraints, most deliveries from the Seabase to ground units will be by rotary winged aircraft (Seabase is being used because of limited access to suitable land port facilities). Expeditionary land operations call for brigade sized units to act independently without assured secure land based lines of communication. Current rotary winged aircraft are restricted in handling TEU containers. Lastly, the supported units lack the material handling equipment and storage capacities to handle TEU deliveries. SM21 will conduct experimentation to explore alternatives to meet these challenges and constraints.

Tracking: While tracking containers may be relatively easy and efficient. Tracking packages that go to multiple locations within the containers is more problematic. This problem is exacerbated in fluid tactical situations, where unit locations and addresses change frequently as units are reassigned to new locations or formations.

Tracking issues also begin to enter into the areas of container security. More and more demands are being placed on companies to be able to document that once a container has been sealed, that it remains unopened during its journey from origin to destination. Assuring the physical security of cargos is a complex issue. In addition, information in the forms of manifests to describe contents and itineraries to describe routes must also have protections to assure their accuracy and integrity. These are issues that will concern movements of cargos to Sea bases, and are dealt with in greater detail in the SM21 study Regional Smart and Secure Trade Corridor and Joint Force Deployment Force Protection Requirements Technical Report.

Demand Issues: Size is but one issue when determining the appropriate method of packaging supplies for unit consumption. Another is the nature of demand. CL I, III, and V are consumptive supplies and their needs can be determined to an extent by knowing the density of populations and the activities those populations are engaged in. CL I, III, and V are also heavy volume items, but the range of the majority of demands for these items are limited.

Demands for items of CL II, VIII, and IX are more demand driven. While overall volumes can be predicted, specific line item requirements on a daily basis are much more difficult to determine. Also, because of the critical nature of CL VIII and IX items, there may be very time line requirements, that if specific parts or specific medicines are not available, then a vehicle will not be functional or a soldier may die. Thus how these items are aggregated, packaged, and moved, may be very different from how cases of MREs or cases of small arms ammunition are moved in the supply system.

Yet other commodities, like CL IV (Barrier Materials), or CL VII (Major End Items) are often large, bulky, heavy items, are not required on a regularly scheduled basis - like CL I, III, and V, and are often in response to specific demands for specific items – like CL IX or CL VIII and may have very time sensitive delivery dates.

A new dimension that will become more important in a sense and respond logistical scenario is defining aggregation or nesting properties. Depending on the nature of the commodity, is it moved in bulk, like liquid CL III petroleum products, or tracked as a serialized item, like an M-16 rifle? How does nesting affect naming conventions?

Nesting Issues: For our purposes, a single NSN item is an ITEM. When two or more ITEMS are banded together in some form (and can be different NSN items), then we have a PACKAGE. If PACKAGES and/or PACKAGES and ITEMS are bound together in a larger package, they larger package becomes a PARENT PACKAGE with NESTED PACKAGES and/or ITEMS. PACKAGES, ITEMS, and/or PARENT PACKAGES mounted on platforms to make movement by Material Handling Equipment (MHE) become LOADS. LOADS and NESTED PACKAGES often are the first level that items will be manifested for shipment. LOADS may be either pure

loads, or mixed loads, and may be defined by either commodity or destination. A pure commodity load contains one class of supply, and a pure unit load would go to one DODACC addressee. LOADS may be further classified by mode of transportation, PALLET (for aircraft), TRUCKLOAD, TRAINLOAD, or CONTAINER for surface movement and SHIPLOAD for sealift. The final level of aggregation would be inventory, to indicate materials accounted for by a unit or supply activity.

Different units and levels of command have different needs to know what is being moved and how. For example, a 20 foot ISO container with unit arms room materials, including the Armorer's toolkit, a dozen M-16 rifles on two rifle racks, cases of small arms ammunition, 30 bayonets in a box, 4 sets of night vision goggles, and 3 cases of MRE for Alpha Company 1/3rd Infantry would have a variety of interests. At Theater level, the question may be, which ship is 1/3 Infantry materials and equipment on? A ships manifest list will have the containers aboard, but may not identify who the ultimate hand receipt holder is, or if all the items for that unit on the ship are all of that unit's items. Brigade may want to know which containers have Arm's Room materials. The container manifest may answer that inquiry. Battalion may need to know how many M-16's are in what container, and if they get moved, where do they get moved to. In this case, RFID information on the container may not be sufficient to provide information on packages within the container.

The point this scenario illustrates is inventory level aggregations, who owns specific equipment; LOAD aggregations, both SHIPLOAD and CONTAINERS that have manifest information; may have NESTED PACKAGES, such as cases of ammunition, bayonets in boxes, or rifles in rifle racks; and NESTED ITEMS, night vision goggles, toolkits, etc., all with different accountability and tracking requirements. For Sense and Respond Logistics to work properly, one needs to know not only that 1/3rd Infantry has a container on the ship, but that one of the containers has Arms Room materials, and if need be, locate specific serialized items, such as an M-16 rifle. This will also be critical knowledge in providing selective download capabilities from T-AKE inventory stocks.

In the expeditionary warfare support scenario, it becomes important to know when and where items are aggregated, when and where they are disaggregated, when and where they are reconfigured.

Elastic Aggregation: The challenge in supporting the supply chain/inventory management requirements of a Seabase, are the challenges of supporting the warfighter in general. As materials move from points of origin (vendors, depots, installations), to ports of embarkation, they must be aggregated in some fashion, either by commonality of commodity or by commonality of destination. The purer an aggregation can be, the easier it will be to reconfigure in transit.

Items going by sealift are generally aggregated into standard ISO containers. ISO containers are designed along with specialized ships, to maximize ship carrying capacities by volume and weight. Dense packing formations minimize the ability to selectively offload containers in a specific order rather discharge is dictated by loading order and trim factors.

T-AKE's supporting Seabase operations must have capabilities to selectively off load inventory. For this reason, and difficulties in transferring load ISO containers while both ships are in open waters, an assumption is made that the containers loaded at a CONUS SPOE must be downloaded and reconfigured at an advanced base or intermediate staging base supporting the Seabase. ISO containers will not be loaded onto T-AKEs.

The ability of the advanced base to reconfigure CONUS ISO container loads into depot storage locations and/or mission configured loads⁴⁰ for the T-AKE will be greatly enhanced if a JDDSP type information fusion center is available to integrate knowledge of the ship's cargo with the advance bases ITV sensor network to rapidly identify containers and their contents. Collaboration with the JDDSP will allow the advanced base the opportunity to plan and dynamically re-plan work schedules based on information provided from the SM21 Smart-Loading service that is being designed to identify containers by location on the incoming vessel and manifest information on each container.

Load out of the T-AKE will also require careful Smart-Loading in collaboration with warfighter needs as the T-AKE will need to configure both materials for general support and must have very precise information concerning what is stored in each storage slot. There will also be a need to configure specific delivery loads for specific units engaged in sea based logistics supported operations (afloat or on the ground). This reconfiguration would suggest packaging direct mission support items in packages that can be easily handled both by rotary winged aircraft that will deliver supplies to ground units and can be handled by line companies with limited storage capacities (2.5 to 5 ton trucks, HMMWVs, etc) and limited material handling equipment.

The challenge for the JDDSP is to be able to package materials bound for the warfighter for efficient transport from the CONUS SPOE to the advanced base while:

- Maintaining visibility down to serialized items when necessary;
- Know the contents and location of containers as they are loaded onto the ship;
- Communicating the ship load plan, down to container content and location level; and
- Being able to dynamically reach and redirect specific items even during loading operations.

The supply chain must be robust enough to push known requirements, yet agile enough to react to changes in events and demands.

An Alternative: One such technology worthy of further exploration is the Inteligistics 5QuadPodTM. This system is based on five interlocking frames, forming a TEU sized container, with modular containers that can easily slide into or be pulled out of the frames. Ten interlocked frames would make a FEU sized container, and 13 frames would fit on a 52' flatbed trailer. The frames are designed with both active and passive RFID capabilities to allow for identification of the TEU and of specific modular containers within the 5QuadPodTM down to items within the modular containers.

⁴⁰ In this case, mission configured loads refer to the T-AKE's mission to support the seabase, not loads configured to support a mission type.

4.0 Prime Vendor/Direct Vendor Delivery (PV/DVD) Integration

Similar to issues involving ASL is the integration of PV/DVD materials. Military ships afloat supporting active military operations ashore, because of hostilities or lack of infrastructure, are not designed to interface with commercial air or sealift carriers. The question becomes, where do these goods and materials enter the DoD distribution system? Where do the PV/DVD vendors deliver to? Who has the capability of tracking items transported by vendors and diverting them when and if necessary? The JDDSP provides a node and capabilities within CONUS and at advanced base as an optional trans-load or delivery point for PV/DVD shipments.

5.0 Transformational Concepts

Transformation is not only developing new concepts, operations, processes, or tools, but is also utilization of existing concepts, operations, processes and tools in new and dynamic ways. The promise of the JDDSP and Sea-Base is not so much in new concepts that can be developed, but in how to better leverage emerging technologies, using legacy systems and concepts in new and dynamic ways.

Improved Metrics: Strategic Mobility 21 examined issues involved in meeting the capability requirements of future expeditionary force projection, particularly as they apply to assuring access to strategic ports for POE operations. A solution provided by SM21 involves the development and utilization of dual use inland port facilities with a new emphasis and focus on communication flow.

Instead of the current emphasis on tonnage shipped with an emphasis on meeting point to point EAD/LAD (Earliest Arrival Date/Latest Arrival Date) windows, the introduction of Sense and Respond Logistics creates the need for better metrics. Sense and Respond Logistics requires the measurement of response times to locate specific items and redirect them when necessary to accelerate movement through the system.

The success of the system is the number and percentage of items delivered to the right place at the right time and the measure of fully capable equipment readiness. These measures are much different than the current measurements of average customer wait times (time between submissions of requisitions to fulfillment). The JDDSP SOS architecture and SM21 SOA support the required change in focus and the perspectives of successful deployment and distribution operations.

Operational Focus Change: The JDDSP changes the focus of deployment and distribution operations from an installation production focus to a call forward focus to move items at specific times in specific orders so they can be loaded to meet warfighter deployment and sustainment needs, with new definitions of maximizing the utilization of lift assets, not merely tons per lift, or percent of capacity used.

The JDDSP, with its location near the primary SPOE, is in a better position to host the operational C² elements that will execute deployment and distribution operations from CONUS. Astride the main flow, the JDDSP is better able to divert loads to other SPOE operations when that makes sense, while also being able to divert items from surface to air when demands for expedited movement make sense. The JDDSP physical facility design concept includes the requirement for a commercial freight airport capable of handling military transport aircraft.

Dynamic diversion capabilities will be most critical for demand sensitive commodities, like CL VIII medical items, and CL IX repair parts where identifying the specific components of the volume demand are difficult, and the criticality of a specific item may be very high. This situation was most dramatically illustrated in the Rand study of repair parts support during OIF

which found a high mismatch between items authorized in the ASL versus CL IX parts needed to support the force during combat operations⁴¹.

Experimentation Platform: SM21 provides a venue to experiment, primarily through modeling and simulation, with alternatives to ASL forward stocks. Including the Sea-Base you can position ASL stockage forward into theater, at the theaters edge (Sea-Base), at the advanced base, or in CONUS, and be able to experiment with tradeoffs involving transport costs, storage costs, availability of storage, availability rates, fleet demand vs. theater demand, responsiveness, etc.

Critical Functions: Critical functions will become the abilities to locate requested items, release them, package, transport, exchange modes, and deliver within required time frames. Development of services within the SM21 SOA will help meet these challenges. The SOA will enable the measurement of system performance, as opposed to strictly node performance, with emphasis on how well a node collaborates and interfaces with other system nodes. The goal of nodes should be to assure accurate knowledge of what is entering the DoD supply chain (in particular direct vendor delivery goods) provide the ability to rapidly divert shipments (change modes or destinations), and maintain accuracy of supply and transport movement forward to the next node in the delivery chain.

Dynamic Redirect: As the transition from the mass distribution logistical systems, with relatively rigid movement lanes, is completed distribution stakeholders will be able to know where items are in the pipeline (commercial or military) and also, when appropriate, change movement instructions. These capabilities, particularly with a multi-modal infrastructure, such as a JDDSP, allow shipment diversions to more effectively expedite high priority material flows or reduce transportation costs when priorities are lowered. The multi-modal nature of the JDDSP makes it an ideal location to develop Vendor Managed Inventory concepts and principals.

⁴¹ Sustainment of Army Forces in Operation Iraqi Freedom, Eric Peltz, Marc L. Robbins, Kenneth J. Girardini, Rick Eden, John M. Halliday, Jeffrey Angers, Rand Corporation 2005

APPENDIX B: JDDSP SUPPORT METRICS

Task List	Metrics	Standards
JDDSP (JL(D) JIC) 1.1.1 Transport forces and accompanying supplies to points of need	Percent of required forces delivered with 15 days of supply by RDD in immediately employable configuration	80%
	Percent of required forces delivered with 15 days of supply by LAD with JRSOI	20%
JDDSP (JL(D) JIC) 1.1.1 Transport forces and accompanying supplies to points of need	Percent of required forces delivered with 15 days of supply by RDD in immediately employable configuration	80%
	Percent of required forces delivered with 15 days of supply by LAD with JRSOI	20%
JDDSP (JL(D) JIC) 1.1.1.1 Transport forces and accompanying supplies directly to theater designated points of need bypassing traditional PODs	Percent of required forces directly delivered to point of need	100%
JDDSP (JL(D) JIC) 1.1.1.2. Transport forces and accompanying supplies directly to theater PODs	Percent of required forces directly delivered to theater PODs	100%
JDDSP (JL(D) JIC) 1.1.1.3 Conduct enroute replenishment operations	Percent of enterprise/joint force lift assets replenished, maintained, and properly crewed at levels set by the JDDE	100%
JDDSP (JL(D) JIC) 1.1.2 Conduct reception and staging operations	Percent of forces prepared for onward movement	100%
JDDSP (JL(D) JIC) 1.1.2.1 Conduct reception operations	Percent of rated reception throughput achieved	100%
JDDSP (JL(D) JIC) 1.1.2.2 Conduct staging operations	Percent of rated staging throughput achieved	100%

Task List	Metrics	Standards
JDDSP (JL(D) JIC) 1.2.1 Transport forces and accompanying supplies to points of need	Percent of forces delivered battle-ready within one day of RDD	97%
JDDSP (JL(D) JIC) 1.2.1.1 Conduct onward movement operations	Time to provide onward movement assets	24 Hours
	Percent of onward movement requirement met	97%
JDDSP (JL(D) JIC) 1.2.1.2 Conduct enroute replenishment operations	Percent of JFC enroute replenishment requirements met within 24 hours of JFC notification	100%
JDDSP (JL(D) JIC) 1.2.2 Support reception and staging incident to intra-theater movement	Percent of enterprise forces prepared to support reception and staging within 36 hours of JFC notification	100%
JDDSP (JL(D) JIC) 1.2.2.1 Conduct reception operations	Percent of rated reception throughput achieved	100%
JDDSP (JL(D) JIC) 1.2.2.2 Conduct staging operations	Percent of rated staging throughput achieved	100%
JDDSP (JL(D) JIC) 2.1 Deliver supplies to the point of need	Percent of all classes of supply accurately delivered to support operational requirements	Emergency resupply within 6 hour CWT; reliability of 97%; accuracy of 95% to multiple customers. Emergency precision delivery to the point of need (e.g. 8 digit MGRS/designated Seabase) Routine- 3 day CWT; 97% reliability rate; accuracy rate - 95% to multiple customers

Task List	Metrics	Standards
JDDSP (JL(D) JIC) 2.1.1 Position sustainment stocks	Backlog at sustainment nodes	No more than 5% of the node's throughput capacity
	Percent of frustrated cargo	1%
	Percent of visibility of units/cargo for distribution	100%
	Time to achieve minimum theater supply stock levels	Less than 3 days
	Delay due to logistics short falls	0 days
JDDSP (JL(D) JIC) 2.1.2 Cross-level sustainment	Time to identify shortfalls and identify potential sources for cross-leveling	3 hours
	Time to complete cross-leveling action	6 hours
JDDSP (JL(D) JIC) 2.1.2.1 Deliver cross-leveled materiel to end user	Cross-leveled materiel moved to the right time, to the right place, in the right quantity	Emergency precision delivery to the point of need (e.g. 8 digit MGRS/designated platform for afloat units)
		Emergency cross-leveling will be complete within 6 hours with a reliability of 97% and an accuracy of 95% to multiple customers
JDDSP (JL(D) JIC) 2.1.2.2 Coordinate replenishment of cross-leveled materiel	Time to replenish stocks	Routine cross-leveling replenishment will be complete within 3 days with a reliability rate of 97% and an accuracy rate of 95% to multiple customers

Task List	Metrics	Standards
JDDSP (JL(D) JIC) 2.1.3 Build tailored sustainment packages	Percent of tailored packages not opened until point of need	95%
	Percent of package items that meet unit requirements	97%
	Fill rate at the source of supply	95% within 72 hours
JDDSP (JL(D) JIC) 2.2 Expand distribution capability to support global sustainment surge requirements	Time to initiate expansion to meet requirements	12 Hours
	Time to establish expanded capabilities	2 Days
JDDSP (JL(D) JIC) 2.3 Conduct retrograde operations	Time to return materiel to designated sites	No more than 5 Days by air No more than 30 Days by sea
	Days awaiting retrograde from theater collection points	No more than 3 Days
JDDSP (JL(D) JIC) 2.3.1 Conduct retrograde of supplies	Time to return supplies, (by class of supply), to designated supply distribution centers	No more than 5 Days by air No more than 30 Days by sea
	Days that supplies, (by class of supply), await retrograde from theater collection points	No more than 3 Days
JDDSP (JL(D) JIC) 2.4.1. Integrate performance-based logistic support activities	Percent of PBL support integrated into the distribution and sustainment effort Percent of PBL provided sustainment at the right time, to the right place, in the right quantity	97% 95% of contracts are executed to negotiated standards
JDDSP (JL(D) JIC) 2.4.2 Coordinate direct vendor delivery	Percent of direct vendor delivery requirements integrated into the distribution and sustainment effort	97%
	Percent of direct vendor delivery requirements at the right time, to the right place, in the right quantity	95% of direct vendor delivery contracts are executed to negotiated standards
JDDSP (JL(D) JIC) 2.4.2 Coordinate direct vendor delivery	Percent of direct vendor delivery requirements integrated into the distribution and sustainment effort	97%

Task List	Metrics	Standards
	Percent of direct vendor delivery requirements at the right time, to the right place, in the right quantity	95% of direct vendor delivery contracts are executed to negotiated standards
JDDSP (JL(D) JIC) 2.5 Deliver replacement/augmentation personnel	Percent of personnel delivered by required delivery date	97%
JDDSP (JL(D) JIC) 3.1.1.3 Provide JDDE decision support	Time to provide all relevant data to support the JDDE decision process	24 hours
JDDSP (JL(D) JIC) 3.1.1.3.1 Perform mode/node distribution optimization analysis	Percent of mode/nodes that are part of the analysis T	99%
	Time to complete mode/node optimization analysis	4 hours
JDDSP (JL(D) JIC) 3.1.1.3.2 Conduct JDDE modeling and simulation	Time to define problem, assemble and validate data, construct or modify model, verify models, validate models, and conduct analyses	6 hours
JDDSP (JL(D) JIC) 3.1.1.4 Conduct integrated planning of JDDE assets	Time to review and validate enterprise requirements	24 Hours
	Time to provide deployment & redeployment risk assessments and options	24 Hours
JDDSP (JL(D) JIC) 3.1.1.4.1 Conduct JDDE lift asset planning	Time to develop terminal plans	24 Hours
	Percent of initial plans requiring revision	Less than 5%
JDDSP (JL(D) JIC) 3.1.1.4.2 Conduct JDDE terminal planning	Time to develop terminal plans	24 Hours
	Percent of initial plans requiring revision	Less than 5%
JDDSP (JL(D) JIC) 3.1.1.4.3 Conduct JDDE organization planning	Time to develop terminal plans	24 Hours
	Percent of initial plans requiring revision	Less than 5%
JDDSP (JL(D) JIC) 3.1.2 Control JDDE Operations	Percent of the JDDE operations conducted according to JDDE plans	100%

Task List	Metrics	Standards
JDDSP (JL(D) JIC) 3.1.1.4.4 Conduct planning for JDDE lines of communication	Time to develop terminal plans	24 hours
	Percent of initial plans requiring revision	Less than 5%
JDDSP (JL(D) JIC) 3.1.2.1 Share information among all elements of the JDDE	Percent of JDDE personnel participating in communities of interest	100%
	Percent of JDDE elements networked	100%
JDDSP (JL(D) JIC) 3.1.2.1.1 Utilize common logistic data (data transparency)	Percent of logistics data common to all JDDE participants	100%
JDDSP (JL(D) JIC) 3.1.2.2 Provide visibility of JDDE assets within the common operational picture	Percent of TAV	100%
	Percent of JDDE assets reporting information to the COP	100%
	Percent of required users that have access to relevant portions of the COP	100%
JDDSP (JL(D) JIC) 3.1.2.3 Redirect materiel	Percent of materiel redirected Time to redirect materiel	As required by JFC or JDDE
	Delay in materiel delivery due to redirection operations	Less than 4 hours Less than 4 hours
JDDSP (JL(D) JIC) 3.2.1 Operate JDDE lift assets	Percent of required lift assets ready to meet operational requirements	100%
JDDSP (JL(D) JIC) 3.2.1.1 Expand joint distribution lift capabilities	Time to initiate lift expansion to meet requirements	12 Hours
	Time to establish expanded lift capabilities	5 Days
JDDSP (JL(D) JIC) 3.2.1.1.1 Execute contingency contracting for commercial, host-nation, and inter-agency lift assets	Percent of commercial, host-nation, and inter-agency contracts approved	100%
	Time to execute a contingency contract for lift assets	5 Days
JDDSP (JL(D) JIC) 3.2.1.1.2 Manage commercial, host-nation, and inter-agency lift assets	Percent of required lift capabilities available to execute movements	95%

Task List	Metrics	Standards
JDDSP (JL(D) JIC) 3.2.1.3 Manage a global distribution container system	Percent of TAV of containers	100%
	Percent of containers positioned to meet JFC requirements	100%
JDDSP (JL(D) JIC) 3.2.1.4 Conduct selected onload/offload	Time to load/unload lift platforms	IAW standards for lift asset
JDDSP (JL(D) JIC) 3.2.2 Operate JDDE terminals	Percent of required terminals ready to meet operational requirements	100%
JDDSP (JL(D) JIC) 3.2.2.1 Perform terminal operations	Aggregate throughput capacity (short tons/day, pax/day, pieces/day, gallons/day)	100% of TPFDD requirements
	Aggregate square feet / cubic feet of storage capacity Backlog at nodes	100% of TPFDD requirements
	The percent of CWT for items attributable to processing at terminals	No more than 5% of the node's throughput capacity
JDDSP (JL(D) JIC) 3.2.2.1.1 Conduct onload/offload operations	Time to load/unload lift platforms	IAW standards for lift asset
JDDSP (JL(D) JIC) 3.2.2.1.2 Conduct sorting/routing activities	Percent of incorrectly sorted items	1%
	The percent of CWT for items attributable to sorting activities	2%
JDDSP (JL(D) JIC) 3.2.2.2 Expand terminal operations capabilities	Time to initiate expansion to meet requirements	12 Hours
	Time to establish expanded capabilities	2 Days
JDDSP (JL(D) JIC) 3.2.2.2.2 Manage commercial, host-nation, and inter-agency terminals	Percent of terminal capacity available for JDDE use	100% of negotiated level
JDDSP (JL(D) JIC) 3.2.3 Operate JDDE organizations	Time to employ organizations' capabilities from notification	2 Days
JDDSP (JL(D) JIC) 3.2.3.1 Expand organizational operations capabilities	Time to initiate expansion to meet requirements	12 Hours
	Time to establish expanded capabilities	2 Days

Task List	Metrics	Standards
JDDSP (JL(D) JIC) 3.2.3.1.2 Manage commercial, military, HNS, MN, IA distribution organizations	Percent of organizations' negotiated capabilities available for use by the JDDE	100%
JDDSP (JL(D) JIC) 3.2.4 Maintain JDDE Lines of Communication	Percent of required LOCs maintained to meet operational requirements	100%
JDDSP (JL(D) JIC) 3.2.4.1 Expand lines of communication	Time to initiate expansion to meet requirements	12 Hours
	Time to establish expanded capabilities	2 Days
JDDSP (JL(D) JIC) 3.2.4.2 Integrate JDDE lines of communication actions with commercial, host-nation, and inter-agency activities	Time for JDDE LOC requirements to be synchronized before movement	2 hours
	Percent of JDDE LOC requirements synchronized before movement	100%

GLOSSARY

Terminology	Definition
ACSA	Acquisition & Cross Servicing Agreement
ACTD	Advanced Concept Technology Demonstration
AFFOR	Air Force Forces
AIS	Automated Information Systems
AIT	Automatic Identification System
AMC	Army Material Command
APOE	Aerial Port of Embarkation
APS	Agile Port System
ARFOR	Army Forces
ASD NII	Assistant Secretary of Defense for Network & Information Integration
ASL	Authorized Stockage Loads
AT 21	Agile Transportation for the 21 st Century
AV	All Views
BCS ³	Battle Command Service Support System
BCT	Brigade Combat Team
BEA	Business Enterprise Architecture
BSB	Brigade Support Battalion
C ²	Command and Control
C-TPAT	Customs and Trade Partnership Against Terrorism
CARP	Cargo Arrangements and Routing Program
CASCOM	Combined Arms Support Command
CBA	Capabilities Based Assessment
CBP	Capabilities Based Planning
CCDoTT	Commercial Deployment of Transportation Technologies
CFAST	Collaborative Force Building, Analysis, Sustainment, and Transportation
CHCP	Container Handling Cooperative Program
CHP	California Highway Patrol
CFS	Cargo Flow Simulation
CINC	Commander in Chief
CLF	Combat Logistics Force
COA	Courses of Action

Terminology	Definition
COCOM	Combatant Commander
COI	Critical Operational Issues
CONOPS	Contingency Operations
CONUS	Continental United States
COP	Common Operating Portal
COTS	Commercial off the Shelf
CTO	Chief Technical Officer
CWID	Coalition Warrior Interoperability Demonstration
CWT	Customer Wait Time
DAC	Dynamic Adaptive Command and Control
DCR	DOTMLPF Change Requirement
DFW	Dallas Fort Worth
DITSCAP	Defense Information Technology Security Certification & Accreditation Process
DLA	Defense Logistics Agency
DoD	Department of Defense
DODIC	Department of Defense Identification Code
DOS	Day of Supply
DOTMLPF	Doctrine, Organization, Training, Material, Leadership & Education, Personal, and Facilities
DPO	Distribution Process Owner
DVD	Direct Vendor Delivery
E to E	End to End
ESC	Expeditionary Support Command
EAD	Earliest Delivery Date
EUCOM	European Command
FEU	Forty Foot Equivalent Unit
FLJFC	Focused Logistics Joint Functional Concept
FLE	Future Logistics Enterprise
FLOCTOC	Future Logistics Operational Capability Technical Operations Center
FMTV	Family of Medium Tactical Vehicles
FORSCOM	Forces Command
FSSC	Fleet Supply Support Command

Terminology	Definition
GATES	Global Air Transportation Execution System
GCCS	Global Command Support System
GCSS	Global Combat Support System
GIG	Global Information Grid
GOTS	Government off the shelf
GFS	Global Fleet Station
GSA	General Services Administration
GTN	Global Transportation Network
GWOT	Global War on Terrorism
HA	Humanitarian Assistance
HBCT	Heavy Brigade Combat Team
HEMTT-LHS	Heavy Expanded Mobile Tactical Truck–Load Handling System
HNS	Host Nation Support
IA	Interagency
IBCT	Infantry Brigade Combat Team
IBS	Integrated Booking System
ICD	Initial capabilities Document
ICODES	Integrated Computerized Deployment System
ILC	Integrated Logistics Capabilities
IP MTOPS	Inland Port-Multi-modal Terminal Operating System
ISB	Intermediate Staging Base
ISO	International Organization of Standards
ISR	Intelligence, Surveillance, and Reconnaissance
IT	Information Technology
ITS	Intelligent Transportation System
ITV	Intransit Visibility
J Ops C	Joint Operations Concepts
J – 4	Logistics Staff Section, Joint Command
JCIDS	Joint Capabilities Integration & Deployment System
JCTD	Joint Concept Technology Demonstration
JDDE	Joint Deployment and Distribution Enterprise
JDDOC	Joint Deployment and Distribution Operations Center

Terminology	Definition
JDDSP	Joint Deployment and Distribution Support Platform
JDPO	Joint Deployment Process Owner
JDST	Joint Decision Support Tool
JETA - SPOD	Joint Enable Theater Access Seaport of Debarkation
JFC	Joint Functional Concept or Joint Forces Commander
JFCT	Joint Forces Collaborative Toolkit
JFCOM	Joint Forces Command
JFP	Joint Force Protection
JFRG II	Joint forces Requirements Generator
JIC	Joint Integrating Concept
JIM	Joint Intermodal Multinational
JL (D) JIC	Joint Logistics (Distribution) Joint Integrating Concept
JLETT	Joint Logistics Education Experimental Training Test Bed
JLOTS	Joint Logistics Over the Shore
JMIC	Joint Modular Intermodal Container
JMIDS	Joint Modular Intermodal Distribution System
JMIP	Joint Modular Intermodal Platform
JMMR	Joint Monthly Readiness review
JOA	Joint Operational Area
JOC	Joint Operation Concepts
JOPES	Joint Operations Planning and Execution System
JRAE	Joint Rapid Architecture and Engineering
JROC	Joint Requirements Oversight Council
JRSOI	Joint Reception, Staging, Onward Movement, and Integration
JT LOG C ²	Joint Logistics Command and Control
JTAV	Joint Total Asset Visibility
JTL	Joint Theater Logistics
JV	Joint Vision
JWCA	Joint Warfighting Capabilities Assessment
JMSR	Joint Materiels Standards Roadmap
JRSOI	Joint Reception Staging Onward movement and Integration
JSOTF	Joint Special Operations Task Force

Terminology	Definition
LAD	Latest Arrival Date
LHS	Load Handling System
LIN	Line Item Number
LMSR	Large Medium Speed Roll on / Roll off
LOCS	Lines of Communication
LOGCOP	Logistics Common Operating Picture
LRP	Logistics Release Point
MAGTF	Marine Air Ground Task Force
MARFOR	Marine Forces
MCB	Marine Corps Base
MCO	Major Contingency Operations
MDSS-II	Marine Air-Ground Task Force (MAGTF) Deployment Support System
MEB	Marine Expeditionary Brigade
MEF	Marine Expeditionary Force
MMTM	Multi-Modal Terminal Model
MN	Multinational
MNE – 5	Multinational Experiment – 5
MOG	Maximum on Ground
MoE	Measure of Effectiveness
MoP	Measure of Performance
MOTCO	Military Ocean Terminal Concord
MPF (F)	Maritime Prepositioning Force (Future)
MPG	Maritime Prepositioning Group
MRO	Material Release Order
MUA	Military Utility Assessment
NATO	North Atlantic Treaty Organization
NAVSEA	Naval Sea Systems Command
NAVSUP	Naval Supply Systems Command
NAVFOR	Navy Forces
NCEDS	Net Centric Enterprise Services
NOIC	Net Centric Operations Industry Consortium
NCP	National Contingency Plan

Terminology	Definition
NCW	Net Centric Warfare
NEW	Net Explosive Weight
NGO	Non Governmental Organization
NIACAP	National Information Assurance Certification & Accreditation Process
NII	National Information Infrastructure
NoMoDD	Node Management and Deployable Depot
NORTHCOM	Northern Command
NSN	National Stock Number
NTC	National Training Center
OCONUS	Outside the Continental United States
OCR	Optical Character Reader
OEM	Original Equipment Manufacture
OEMS	Order Entry Management Systems
OIF	Operation Iraqi Freedom
OMFTS	Operational Maneuver from the Sea
ONR	Office of Naval Research
OPTEMPO	Operational Tempo
OV	Operational Views
PFC	Protocol Functional Collection
POL	Petroleum, Oil, and Lubricant
POLA	Port of Los Angeles
POLB	Port of Long Beach
POM	Program Objective Memorandum
PV	Prime Vendor
PSA	Port Support Activity
RDD	Required Delivery Date
RFID	Radio Frequency Identification
ROMO	Range of Military Operations
S & R	Sense and Respond
SBLO	Sea-Base Logistics Optimization
SCASN	Southern California Area Supply Network
SCLA	Southern California Logistics Airport

Terminology	Definition
SCOR	Supply Chain Reference Model
SDDC	Surface Deployment and Distribution Command
SDTE	Synchronous Data Terminal Equipment
SIPERNET	Secure Internet Protocol Router Network
SM 21	Strategic Mobility 21
SME	Subject Matter Expert
SOA	Service Oriented Architecture
SOCAL	Southern California
SPG	Strategic Planning Guidance
SPOE	Seaport of Embarkation
SRL	Sense and Respond Logistics
SSSP	Steady State Security Posture
STOM	Ship to Objective Maneuver
STRACNET	Strategic Rail Network
STRAHNET	Strategic Highway Network
STRATCOM	Strategic Command
SV	Service Views
SOS	Systems of Systems
T-AKE	Auxiliary Cargo (K) and Ammunition (E) Ship
T-AO	Auxiliary Fleet Oiler
TATRC	Telemedicine and Advanced Technology Research Center
TAV	Total Asset Visibility
TC AIMS II	Transportation Coordinator Automated Information Management Systems
TCOS	Trade Corridor Operating System
TD	Theater distribution
TDC	Theater Distribution Center
TEU	Twenty Foot Equivalent Unit
TSA	Transportation Security Agency
TSC	Theater Support Command
TTP	Tactics, Techniques, and Procedure
TV	Technical Views
UDOP	User Defined Operating Procedure

Terminology	Definition
UJCL	Universal Joint Capabilities List
UN	United Nations
USA	United States Army
USCG	United States Coast Guard
USDOT	United States Department of Transportation
USJFCOM	United States Joint Forces Command
USMC	United States Marine Corps
USN	United States Navy
USTC	United States Transportation Command
USTRANSCOM	United States Transportation Command
UNREP	Underway Replenishment
WPS	Worldwide Port System

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